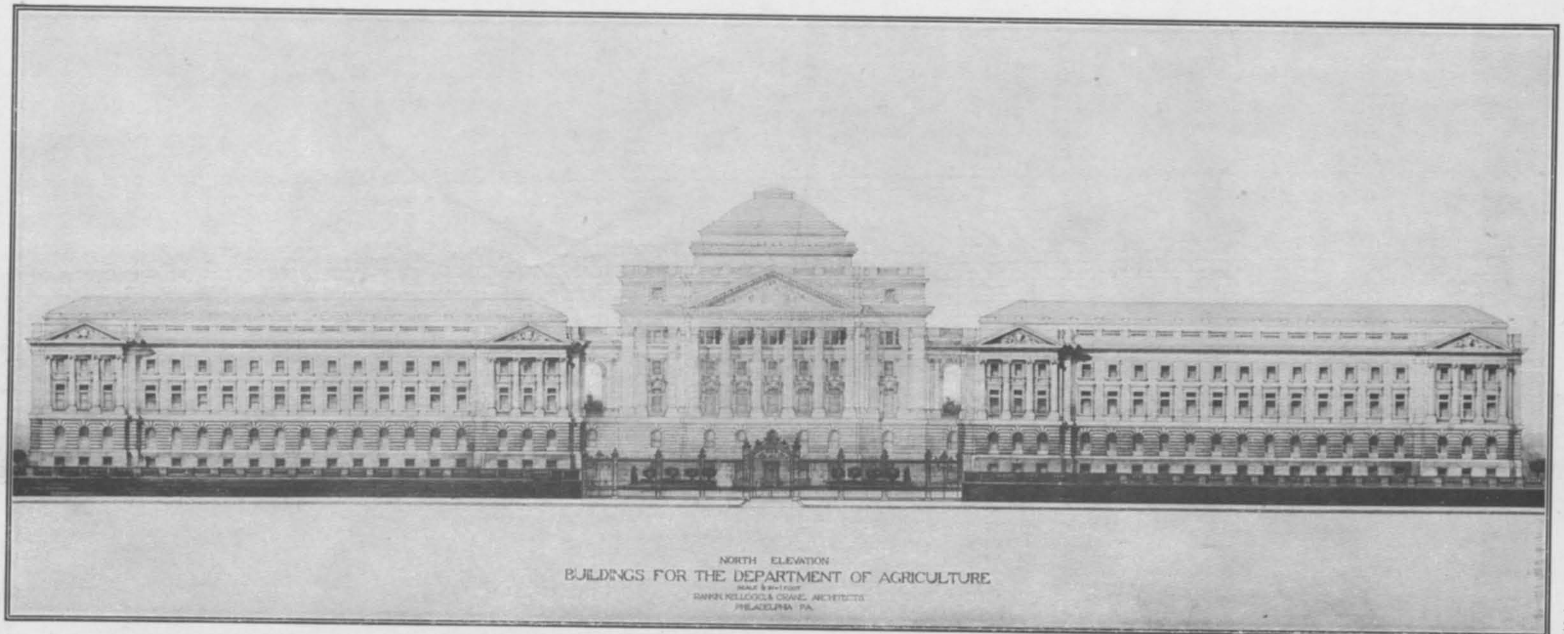

PROPOSED NEW BUILDINGS FOR THE DEPARTMENT OF AGRICULTURE.

THE NORTH FAÇADE, SHOWN IN THIS ILLUSTRATION, IS ABOUT 650 FEET IN LENGTH. THE ADMINISTRATION BUILDING, IN THE CENTER OF THE GROUP, IS SIX STORIES HIGH; THE LABORATORIES, ON EITHER SIDE, FIVE STORIES.

[For cross sections, see Pl. LXII, and for description, see p. 513.]

YEARBOOK

OF THE

UNITED STATES

DEPARTMENT OF AGRICULTURE.

1903.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

2

[CHAPTER 23, Stat. at L., 1895.]

[AN ACT providing for the public printing and binding and the distribution of public documents.]

* * * * * * *

Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

PREFACE.

The tendency of the Yearbook to increase in size, following very naturally the growth of the Department whose work it deals with, led to the production for several years of a book of inconvenient dimensions, and threatened, unless a different system were pursued in its preparation, very soon to make a most unwieldy volume. An earnest effort had to be made, and a change was therefore inaugurated in the preparation of the present volume, with a view to reducing its bulk. The result has been to reduce it by about 200 pages; while the tendency to conservatism in the matter of illustrations, which for the past year or two has characterized all the publication work of the Department, has caused a reduction in the number of plates from 87 in the Yearbook for 1902 to 65 in the present volume.

It has been impossible, of course, to effect such a marked reduction without in some measure restricting the number of articles contributed. The number in this volume, while still considerably above the average since the Yearbook was established, is 32, as against 37 last year and 33 in the Yearbook for 1901. The authors are, however, to be congratulated upon having more nearly than ever before approached the standard of brevity which it has been sought to establish in connection with Yearbook articles, and the average length is but a fraction over 12 pages.

Readers who have been in the habit of consulting the Appendix will find there also evidence of this restrictive policy in the elimination of some features to which they have become accustomed. It is believed, however, that the most important information presented in this part of the Yearbook for permanent preservation has been retained.

At a risk of repetition, it must be again stated for the information of those who desire to possess a copy of the work, that the quota assigned to the Department's use is barely sufficient to supply its own active coworkers, and the great majority of people desiring to secure a copy must, therefore, depend upon their Senators, Representatives, and Delegates in Congress, among whom 94 per cent of the entire edition is divided.

As heretofore, the Editor has been ably assisted in the preparation of the work by Mr. B. D. Stallings and Mr. C. H. Greathouse, assistant editors, the latter being especially charged with the care of the Appendix and the preparation of the Index. Only by the cheerful contribution of considerable extra time on the part of these gentlemen has it been possible to bring the work to completion at this comparatively early date.

GEO. WM. HILL,
Editor Department of Agriculture.

WASHINGTON, D. C., *April 23, 1904.*

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YEARBOOK

OF THE

U. S. DEPARTMENT OF AGRICULTURE.

REPORT OF THE SECRETARY.

To the President:

I have the honor to submit herewith my Seventh Annual Report as Secretary of Agriculture.

EDUCATIONAL REQUIREMENTS OF AGRICULTURAL RESEARCH.

The research work of the Department of Agriculture, covering the sciences of production in the fields and other laboratories where the crops of the country are grown and where they are made more valuable by skill, has required a class of experts not educated by the institutions of learning, where our people have heretofore been prepared for their life work. The development of the Department toward doing all that should be done to help our people secure a greater yield from the soil, and enhance the value of its products, made the training of experts in the Department a necessity.

The country needed scholars along all the lines of work considered in this report. The agricultural colleges of the States are the natural sources from which students for this work should be expected to come, and we have availed ourselves of all the competent graduates of these institutions that could be induced to take up advanced work with us; but the demand has been so great, and the growth of the Department so rapid, that we have been compelled to seek the most competent men wherever we could find them.

The theory of our duty is to help any locality that is struggling with a problem to an early solution of which the experience of our scientists may contribute or where the undertaking is beyond the means at the disposal of the people interested.

To these ends many specialists must be trained, and for these purposes the Department has become a post-graduate institution where groups of sciences are taught and applied. Comparatively little time is devoted to the ascertainment of abstract scientific facts. Every

worker is helping somebody, and while doing this he is contributing to what is known relating to the farm, and to the education of his associates.

Four hundred and ninety-six students have been admitted to the Department for instruction since 1897 as experts in our several lines of work. Two hundred and forty-nine of these still remain with us, not less than 132 having passed into the classified service; 185 have gone elsewhere to teach, experiment, or demonstrate in private enterprise what they have learned from their teachers, who are our best-equipped scientists in their several specialties.

The Department has been extending its work in all parts of the country during the past year wherever the producers from the soil most need help. Our most active efforts have been directed to the stamping out of foot-and-mouth disease in four of the New England States, and in studying the cotton boll-weevil in Texas and demonstrating the growing of cotton successfully in spite of the presence of the pest. Encouraging progress has been made in all the lines of research with which the Department is charged.

OUR SURPLUS PRODUCTION.

Out of their continued abundance, during the past year, the farmers of the nation have contributed food and raw materials for manufactures to hundreds of millions of people in foreign countries, besides sustaining 80,000,000 at home.

A survey of half a century discovers the remarkable character of the movement in which the farmers of this country have become the chief purveyors of the world.

In 1851 our shipments of farm products were valued at $147,000,000, while half a century later, in 1901, they amounted to $952,000,000, an increase of $805,000,000, or about 550 per cent. The farmers' export trade for the decade 1851–1860 amounted to $1,896,000,000, and in the following decade, in spite of the transfer of multitudes of men from productive to destructive life, the total was $2,431,000,000. In the decade after that, the export trade doubled and amounted to $4,864,000,000. In the next decade, the amount grew to $5,740,000,000, and the total for the decade of 1891–1900 was $7,032,000,000, or an average of over $703,000,000 a year. Subsequent to the last-named period this trade has gone on increasing and reached its highest amount in 1901 with exports valued at $952,000,000. The export trade in farm products for 1903 was valued at over $878,000,000, an amount second only to that of 1901.

The consumption of cotton in this country is now greater than that of any other country, and yet the cotton planters of the South not only supplied this market last year, but exported a surplus of 3,569,000,000

pounds, valued at $317,000,000, or for every working day in the year about 12,000,000 pounds, worth more than $1,000,000.

Represented in value, the exports of grain and grain products had about two-thirds of the importance of cotton in the last fiscal year, the value of the export being more than $221,000,000. From 46,000,000 acres of wheat there was a surplus for foreign mouths amounting to 114,000,000 bushels and 20,000,000 barrels of flour, amounts that together represent 204,000,000 bushels of wheat.

Third in importance are the exports of meats and meat products, with a grand total of $178,000,000, to which may be added $35,000,000 for live animals. Quantities that are beyond the grasp of the mind represent the exports of meats and their products. The pounds of beef were 385,000,000; of pork, 551,000,000; of lard, 491,000,000; and of oleo oil, 126,000,000.

The foregoing figures, it should be borne in mind, do not stand for the total production of the farms, but for the surplus production after the wants of the people at home have been satisfied.

THE FARMER'S BALANCE OF TRADE.

The immense exports from the farms of the country lead to an examination of the so-called balance of trade. This examination reveals what seems to have escaped the attention of the public, and that is, that the favorable balance of trade, everything included, is due to the still more favorable balance of trade in the products of the farm.

During the thirteen years 1890–1902 the average annual excess of domestic exports over imports amounted to $275,000,000, and during the same time the annual average in favor of farm products was $337,000,000, from which it is apparent that there was an average annual adverse balance of trade in products other than those of the farm amounting to $62,000,000, which the farmers offset and had left $275,000,000 to the credit of themselves and the country.

Taking the business of 1903, the comparison is much more favorable to the farmers than during the preceding thirteen-year period, since the value of domestic exports over imports was $367,000,000, the entire trade being included, while the excess for farm products was $422,000,000, which was sufficient not only to offset the unfavorable balance of trade of $56,000,000 in products other than those of the farm, but to leave, as above stated, the enormous favorable balance of $367,000,000.

During the last fourteen years there was a balance of trade in favor of farm products, without excepting any year, that amounted to $4,806,000,000. Against this was an adverse balance of trade in products other than those of the farm of $865,000,000, and the farmers not only canceled this immense obligation, but had enough left to

place $3,940,000,000 to the credit of the nation when the books of international exchange were balanced.

These figures tersely express the immense national reserve-sustaining power of the farmers of the country under present quantities of production. It is the farmers who have paid the foreign bondholders.

MAGNITUDE OF PRODUCTION.

The height to which farm production has risen to supply the demands of domestic and foreign consumption should not be overlooked. Taking the range of recent years, there is the product of wheat, 600,000,000 to 750,000,000 bushels, worth to the farmer from $350,000,000 to $450,000,000. On more than 90,000,000 acres grow 2,000,000,000 to 2,500,000,000 bushels of corn, with a value which ran up to more than $1,000,000,000 on the farm in 1902.

The oat crop now reaches close to 1,000,000,000 bushels, with a value of $300,000,000; the barley crop overruns 100,000,000 bushels, worth $50,000,000, and the rice crop in 1902 amounted to 390,000,000 pounds.

One of the most valuable three of all farm crops is that of hay, aggregating about 50,000,000 to 60,000,000 tons, worth $450,000,000 to $550,000,000; ranging between 200,000,000 and 300,000,000 bushels is the potato crop.

The acreage of the cotton crop has displayed a tendency to increase considerably during the last few years, and in 1903 was about 29,000,000 acres; the number of bales produced in recent years ranges from 10,000,000 to 11,000,000, while the value of the entire crop on the plantations has gone as high as $511,000,000 for the crop of 1900, or, if the seed is included, $530,000,000.

Tobacco is another crop of expanding proportions, and the prospect now is that within a few years ten figures will be required to represent the annual production. This crop has now climbed close to 900,000,000 pounds, valued at $60,000,000.

Only some of the principal farm products have been mentioned, but these are sufficient to indicate, in conjunction with information concerning the less important products, that the value of all farm products not fed to live stock for 1903 considerably exceeded their value in the census crop year 1899, when it was $3,742,000,000.

NATIONAL STOCK OF FARM ANIMALS.

The Department's inventory of farm animals January 1, 1903, discovers that while some classes of animals are only holding their large proportions, others are increasing. The horses number 16,557,000, with a value of $1,031,000,000. The mules have increased to 2,728,000, with a value of nearly $200,000,000.

Dairying shows marked expansion, and now depends upon 17,105,000 milch cows, with a value of $517,000,000. Other cattle of all sorts number 45,000,000, with a value of $824,000,000.

The number of sheep has had a tendency to decline at times during the last score of years, but within the last four years has increased decisively, so that now the sheep number 64,000,000, with a value of $168,000,000.

Hogs have remained about stationary in number for many years, and in 1903 were found to be 47,000,000, with a value of $365,000,000.

BETTER DISTRIBUTION OF PROGRESS.

There is one other particular feature of the farmers' improved and gratifying condition that should be noticed, and this seems to have escaped attention. During the long period of time when the new and productive land of the West was easily obtained, and when the number of farms and the amount of production there multiplied at an amazing rate, the farmers of the East and the South suffered under a severe competition and an impending overproduction, and agriculture in these sections, apart from cotton production, was outstripped in the agricultural expansion of the West. Since 1890, however, there has been a turn in the trend of this expansion; the northern half of the Mississippi Valley is not overshadowing the other sections of the country in its rate of expansion as formerly; an improvement in the welfare of farmers in other sections of the country, as well as in the North Central States, is in evidence. In other words, there is a more even distribution of expansion, progress, and welfare than before.

The South, which had been backward in its corn production for many years preceding 1890, finds itself since that time with its fraction of the national production of corn increasing faster than that of any other section; the same is true with regard to wheat, sweet potatoes, and cane and sorghum sirup; and to these may be added tobacco and farm-made butter, and horses, mules, and swine. The South occupies a second place in the rate of increase of production, in comparison with other sections, in buckwheat, hay, apple and peach trees, cattle other than milch cows, and farm-made cheese.

In a similar way, agriculture in the East is rehabilitating itself by gaining faster than in other sections of the country in the production of buckwheat and potatoes, while it stands second in order among the different sections in its increasing production of rye and of sweet potatoes, and in the number of milch cows.

The group of States embracing the Rocky Mountain and Pacific Coast region is showing a larger gain relatively than other sections in the production of rye, hay, apple trees, and farm cheese, and in the possession of sheep and milch cows; while it holds a secondary place in

relative advancement in the production of wheat, oats, barley, potatoes, and farm butter, and in the possession of horses, mules, and swine.

The North Central States have by no means lost for all products the foremost place in rapid rate of advancement that they have enjoyed for many years. Since 1890 this section has increased its production faster than other sections for oats, barley, flax, peach trees, and cattle other than milch cows; and this section does not stand second in rate of advancement in any of the products under consideration.

Thus, it appears that a new life has come to agriculture in all parts of the country, and that there are achievement, hope, and promise for the farmer everywhere.

The above review of our agricultural products and exports is presented not only in grateful acknowledgment of the bountiful Providence which has so generously filled our cup of prosperity, but also from a desire to present thus succinctly to the statesmen and to the men of affairs of this country the value and importance of this vast agricultural industry, supported by three-eighths of our working population, and contributing so greatly to the prosperity of the whole country. It is this vast constituency and still vaster industry that the Department of Agriculture is charged to protect, cherish, and encourage, and its extent can only be appreciated by those who are not brought continuously in direct contact with it, by the perusal and study of the foregoing figures and consideration of the important facts they present.

WEATHER BUREAU.

The Weather Bureau has, through its officials at the various stations throughout the country, taken an active part in public education along meteorological lines. In 12 colleges or universities during the past year Weather Bureau officials have conducted regular courses of lectures or classes of instruction in meteorology and climatology, and at 5 of these institutions the official is a member of the faculty. At 16 stations the officials have delivered occasional addresses outside of their offices to schools or colleges, and at 28 stations they have given frequent talks in their offices to pupils and teachers of schools. In 14 instances they have delivered occasional addresses outside of their offices to farmers' institutes and similar organizations. Only a few years ago there was very little instruction of this nature given in our colleges, universities, or public schools, but the demand for it has rapidly increased. The action of the Bureau in this direction will undoubtedly result in a wider knowledge and a more intelligent understanding of its work, and a consequent increase in its usefulness and value. Many of the young men who receive instruction in these classes are attracted to the service of the Bureau as an occupation, and the

Bureau profits by securing a class of employees with special training and equipment.

The year 1902–3 marks a distinct advance by the Weather Bureau in the science of meteorology, especially in two directions. From the beginning of the weather forecasts by the Government, in 1871, the necessary observations at the several stations have always been reduced to the sea-level plane. It was conceived some years ago that the numerous defects in forecasting might be diminished, and the uncertainty as to the true cause of storms removed, if similar daily charts were also constructed at higher levels, for which purpose the 3,500-foot and the 10,000-foot planes were selected. After much laborious computation, as shown in the barometry report of 1900–1901, the necessary reductions were made, and we now possess daily weather charts on the three planes mentioned. The study of these supplementary maps is going on, with encouraging prospects of more reliable forecasts of the weather conditions, and it is hoped by January 1, 1904, to make them a part of the regular daily work of the forecasting service. At present the improved data are confined to the barometric pressures, but it is most important to secure charts of the temperature on the two upper planes as well. Unfortunately, we have no observations of temperature in the higher atmosphere suitable for this purpose, and they can be secured only by means of numerous balloon and kite ascensions carrying the necessary self-registering instruments.

It has been thought proper for many reasons to establish on the Blue Ridge Mountains, at Mount Weather, Bluemont, Va., a modern meteorological observatory of the best class for scientific research pertaining to problems of weather phenomena. A building for administration and for a school of instruction is being erected, and the plans are well advanced for a suitable power house and shop for balloon and kite ascensions, which will be built during the coming year. The recent advances in solar and terrestrial meteorology justify us in preparing to study at first hand the variations in the solar activity, and the corresponding changes in the weather conditions, especially from season to season. It is a complex problem and will require the best instrumental equipment, the ablest students, and a long series of observations before it can be finally solved. The desirability of being able to foresee a year in advance the type of season probable during a given period is so great as to make it imperative to lay broad scientific foundations at the beginning of the twentieth century, which will be of utility for future generations, who will surely build a great science of cosmical meteorology upon such data as can be supplied by the Mount Weather Observatory.

SUBMARINE CABLES.

New submarine cables in connection with the vessel-reporting and storm-warning services have been laid from Sand Key to Key West,

Fla.; from Southeast Farallone to Point Reyes, Cal.; from Block Island to Narragansett Pier, R. I.; and from Glen Haven to South Manitou Island, Mich., a total of about 50 miles. Additional vessel-reporting stations have been established at Sand Key, Fla., and Southeast Farallone, Cal.

To meet the demands of the maritime and commercial interests of the Pacific coast a cable has been laid between San Francisco and the Farallone Islands, with a weather observatory and vessel-reporting station on the South Farallone Island. A wireless station has also been installed there to insure communication in future should the cable be out of order.

RIVER AND FLOOD SERVICE.

The work of the river and flood service, owing to the numerous and disastrous floods that occurred, has been a prominent feature of the year. Several of the floods were the greatest of which there is authentic record, and were remarkable both for their wide extent and for their destructive character. Our warnings were prompt and timely, and in the main remarkably accurate; and in no instance was the coming of a dangerous flood unheralded. The forecasts of the great floods of March, April, and June, 1903, afford noteworthy examples of the efficiency of this service. This should be extended to the Kansas and other rivers, where no stations have yet been established.

DISTRIBUTION OF FORECASTS AND SPECIAL WARNINGS.

Inadequate appropriations have prevented any extensions in the important work of distributing forecasts and special warnings, and of necessity our efforts have been confined to maintaining the service already in operation, with its various ramifications, and adopting such suggested improvements as might be effected without additional expense.

A marked increase (nearly 20,000) is shown in the number of places receiving forecasts by telephone without expense to the Government of the United States, and with the rapid extension of "farmers' telephone lines" opportunity is afforded for placing weather information directly in the homes of the more progressive agriculturists, as well as in the telephone exchanges of rural centers of population, where it is posted for the general information of the public.

NATIONAL CLIMATE AND CROP BULLETIN.

The National Climate and Crop Bulletin has been issued in the usual form, with charts showing the current temperature and precipitation, extremes of temperatures, and the departures from the normal of

both temperature and precipitation. In this bulletin the current meteorological conditions are discussed in their relation to crop growth from the beginning to the end of the crop season.

BUILDINGS ERECTED AND PROPOSED.

During the past fiscal year, through the appropriations by Congress, it has been possible to erect buildings for use as meteorological observatories for the Weather Bureau at the following-named places, and at a total cost of $32,922.97, viz: Amarillo, Tex.; Modena, Utah; Key West, Fla.; Sand Key, Fla.; Southeast Farallone, Cal.; and buildings are now in course of erection at the following places, the total cost of which will be $70,900, viz: Yellowstone Park, Wyo.; Duluth, Minn.; Devils Lake, N. Dak.; Havre, Mont.; Mount Weather, Va.; Block Island, R. I.; Narragansett Pier, R. I.

The wisdom of erecting buildings for the exclusive use and under the control of the Weather Bureau becomes more apparent every day. It saves to the Government the amount heretofore paid for rent of office quarters, which in many cases are unsuited to our needs, especially as regards the architecture of the roofs for the exposure of meteorological instruments.

BUREAU OF ANIMAL INDUSTRY.

A marked distinction between our country and all others is the more ~~generous~~ nutrition of our people. Our domestic animals contribute to this result, and furnish a large percentage of our exports. This has been brought about by abundance of comparatively cheap grass and grain rather than through superior knowledge of breeding and feeding. We have developed a track horse, a lard hog, and but little else.

The Bureau of Animal Industry has given standing in interstate and foreign commerce to our animals and their products, and is battling successfully with diseases and disabilities originating at home and abroad. It is considering the wisdom of undertaking systematic cooperation with the State experiment stations in the production of types of animals suited to our varying latitudes and conditions, in order that more economy may be observed in production.

CONTAGIOUS DISEASES OF ANIMALS.

The control of the contagious and infectious diseases of animals is one of the most important lines of work in which the Department is engaged, and this work must become more valuable and of greater necessity as the number of animals in the country increases and as traffic with countries in which such diseases exist is further developed.

FOOT-AND-MOUTH DISEASE.

Last year, for the first time in eighteen years, foot-and-mouth disease was discovered in the United States. The manner in which the contagion was brought in is not definitely known, but it evidently came with some articles of merchandise, as it first appeared near the docks of the port of Boston, and spread from there toward the interior. When the existence of this disease was recognized and brought to the attention of the Department the contagion had already spread over the eastern part of the State of Massachusetts and into the States of Rhode Island, New Hampshire, and Vermont. The whole country was menaced with the plague, and it was only by the adoption of radical measures and by the prompt, efficient, and indefatigable work of the inspectors that the contagion was controlled and eradicated.

The plan of work was, briefly, to rigidly quarantine all infected premises and the animals upon them, to slaughter at the earliest practicable moment all susceptible animals on such premises, and to disinfect the stables, pens, and utensils in a thorough manner. Operations were begun December 1, 1902, and the last diseased herd in this outbreak was slaughtered May 9, 1903. The cooperation of the executive departments of the several affected States was prompt and complete, and enabled the Federal authorities to enforce regulations and stamp out the disease wherever it was found. The number of animals slaughtered on account of this disease was 4,461, of which 3,872 were cattle, 360 hogs, and 229 sheep and goats. There was allowed by this Department 70 per cent of the appraised valuation as indemnity. The total amount thus paid was $128,908.57. There were other expenses, such as for salaries, traveling, labor, disinfectants, etc., which were additional to this amount, but the total cost of the eradication of the disease was less than $300,000.

The stock raisers of the country were saved from a great calamity by the successful termination of this work. It is the general history of the disease in other countries that where an outbreak assumes the proportions of the one which existed in New England last winter it spreads over the whole country, affecting sooner or later practically all of the cattle and a large part of the sheep and hogs. As the value of grown cattle shrinks from 20 to 30 per cent in consequence of the disease, as some of these die, together with a considerable proportion of the young animals, and as hogs and sheep are also seriously affected, it is plain that the direct losses from a general extension of the contagion over the country would be some hundreds of millions of dollars, while the indirect losses from domestic quarantines and restrictions on traffic and from embargoes on our export trade would be simply incalculable. These losses were avoided, because the Department had a force of competent and trained veterinarians who were at once taken

from their duties in other parts of the country and concentrated in the infected section, and who loyally and cheerfully endured the hardships of a winter campaign in the rural districts, where the cold much of the time was extreme, the roads blocked with snow, and the difficulties connected with the disposal of the carcasses of slaughtered animals and the disinfection of the premises were almost insurmountable.

SHEEP SCAB.

Energetic work has been carried on during the year with the object of controlling as effectually as possible the contagious disease of sheep known as scabies, or scab. Heretofore but little has been done for the repression of this disease except in the channels of interstate commerce, and it was hoped that the prohibition of the shipment of diseased sheep would be sufficient to cause the owners of such animals to treat them on the farms and ranges, and thus eradicate the contagion. While this result followed in some cases, it is unfortunately true that the greater part of the owners of this class of animals have neglected to take proper measures and have apparently relied upon their ability to elude or deceive the inspectors and run their animals through to market without the actual condition being discovered. The attempts to accomplish this have kept the stock cars and stock pens used for animals in interstate commerce so thoroughly infected that satisfactory progress with the disease could not be made. It was therefore determined to cooperate with some of the worst infected States, and attack the contagion at its origin by stamping it out on the premises where it exists and propagates from year to year. This has required somewhat of an increase of the field-inspection force, but it is apparently only in this way that the disease can be controlled.

The inspectors have inspected in this work during the year an aggregate of 16,444,370 head of sheep, and have supervised the dipping of 2,167,002 sheep, of which 394,636 were dipped twice. This enormous amount of work has had great influence for good, and if continued for a few years, will free the sheep industry from this incubus, which has for many years been the source of great discouragement and loss.

TEXAS FEVER.

The inspection and supervision of cattle in transit from the Texas-fever district has also involved a great amount of work. These animals are capable of spreading contagion through the ticks with which they are infested, and must, therefore, be kept in different cars and yards and driven over different roads from those used for other cattle. It is moreover necessary to inspect many cattle from the district adjacent to the infected section in order to determine definitely that they have not been exposed, and that they may safely be allowed to go forward to market through the channels of interstate commerce

without danger to the animals of any other section of the country. This service required the inspection of 1,620,403 cattle from the infected district, and of 389,525 cattle from the adjacent district. To guard against the spread of the contagion by infected cars, 66,116 of these were cleaned and disinfected by the direction and under the supervision of the inspectors.

It is well known that if Southern cattle are entirely freed from that species of ticks known as the *Boophilus annulatus* they can be allowed to mingle with the most susceptible animals without danger. Many efforts have been made to discover a practicable method for destroying this parasite without injuring the cattle, and the Bureau of Animal Industry has experimented for years with this object in view. Such treatment, if successful, would relieve most of the Southern cattle from quarantine restrictions, and would make these cattle bring more money in the markets of the country. After many failures, apparent success has been reached by dipping the cattle in the crude oil obtained from certain Texas wells. This oil is heavily charged with sulphur, and in the experiments so far made has not materially affected the cattle. It is necessary to regard such a treatment with some reserve until a large number of animals have been treated under the conditions which obtain in the practical shipment of cattle from the infected district to the markets; but it may be said now that this oil has been tried at the animal industry experiment station near Washington with entirely successful results, being distinctly superior to any other substance tested, and that it has also been tried in the field with about 70 head of cattle, the effect being equally favorable. Arrangements are now made for using the treatment on a much larger number of animals, and if, as hoped, no objections to it develop, it will be of inestimable value to the cattle industry of the Southern States.

HOG CHOLERA.

The losses from contagious disease among hogs in the United States have been enormous, probably reaching in some years the aggregate of $75,000,000, and being seldom less than $30,000,000. This Department has for a quarter of a century been conducting scientific experiments with a view to elucidating the nature of the disease and developing some practical treatment by which it might be controlled; and while much has been discovered as to the effects of certain bacilli, and as to the desirability of sanitary measures, no satisfactory method of controlling the disease has been evolved. Recently it has been shown by the Bureau of Animal Industry that there is, at least in some of the outbreaks, a different cause at work from what has heretofore been suspected. When the bacilli which have been supposed to cause the disease are all filtered from the blood, this liquid is still capable of producing the malady and has apparently the same degree of virulence

as it had before filtering. It is yet too early to estimate the proportion of the losses attributed to hog cholera which are caused by this agent, which passes through the finest filters, and which in this condition must be too small to be revealed by the highest powers of the microscope. Investigations are now being made to throw some light upon this question; but enough is already known to make it probable that this discovery will prove of very great importance.

TUBERCULOSIS.

Investigations have been conducted with human and animal tuberculosis, with a view of determining whether the disease is transmissible from man to animals or from animals to man. It has been shown by the experiments which have been made that there are cases of human tuberculosis in which the bacilli are as virulent for cattle as are the bacilli obtained from animals affected with the disease. The conclusion from this fact is that either human and animal tuberculosis are identical and intercommunicable or the persons from whom these virulent bacilli were obtained had been infected with bovine tuberculosis. In either case, it must hereafter be admitted that the tuberculosis of animals is a menace to human health, and that both for economical and for sanitary reasons measures should be adopted for its control.

BLACKLEG.

The work against blackleg continues satisfactory. During the season the Bureau vaccine was used with 775,877 cattle, and the percentage of deaths after vaccination, not counting those animals that were evidently diseased before vaccination, was 0.53; whereas before vaccination the average percentage of losses among the same herds was 2.69.

INSPECTION OF ANIMALS AND ANIMAL PRODUCTS.

The number of certificates of inspection issued for American cattle exported to Europe was 960. The number of clearances of vessels carrying live stock was 634. The number of sheep inspected for export to Europe decreased from 211,224 in 1902 to 111,448 this year. The exports of horses fell off very considerably also, being 3,910 this year, as against 10,967 in 1902. Of the 228,365 cattle inspected for export, 226,613 went to Great Britain.

MEAT INSPECTION.

In the meat-inspection service the number of ante-mortem inspections was as follows: Cattle, 11,988,760; sheep, 14,654,249; calves, 1,041,138; hogs, 31,546,222; horses, 344; a total of all animals of 59,230,713. The following post-mortem inspections were also made: Cattle, 6,165,890; sheep, 8,598,175; calves, 670,173; hogs, 21,827,047; horses, 344—a total of 37,261,629.

The meat-inspection tag or label was placed upon 21,124,318 quarters, 362,689 pieces, and 186 sacks of beef; 8,571,643 carcasses of sheep; 667,259 carcasses of calves; 880,945 carcasses of hogs, and 696,279 sacks of pork.

The meat-inspection stamp was affixed to packages of meat products that had received the ordinary inspection, as follows: 7,520,854 of beef, 59,314 of mutton, 14,601,202 of pork, and 70 of horseflesh—a total of 22,181,440.

The number of cars sealed containing inspected meat products for shipment from official abattoirs and other places was 67,046.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 30,152. Of beef, there were 1,388,633 quarters, 20,422 pieces, 401 bags, and 1,352,291 packages, with a weight of 371,920,737 pounds; of mutton, there were 35,394 carcasses and 22,527 packages, weighing 2,729,013 pounds; of pork, there were 24,380 carcasses and 506,311 packages, weighing 133,122,610 pounds.

The decrease in the certified exports of beef and pork, noted in the last report, continued, the figures showing a decline from the last year of 45,070,025 pounds of beef, and 55,237,401 pounds of pork. The exports of mutton were nearly two and a half times as much as last year, when there were 1,145,248 pounds certified.

There was one shipment of horseflesh, 70 packages, weighing 28,000 pounds.

The cost of the work of the ordinary meat inspection for the year was $711,546.18.

MICROSCOPICALLY INSPECTED PORK.

The exports of microscopically inspected pork to countries requiring inspection decreased 14,572,888 pounds—from 33,681,229 in 1902 to 19,108,341 in 1903. The cost of the microscopic inspection was $78,179.63, being an average of 16 cents for each examination, and for each pound exported 0.41 cent.

IMPORTS FROM MEXICO.

There were imported from Mexico 52,780 cattle, 4,119 sheep, 1,794 goats, and small numbers of other animals. At seacoast ports there were imported 2,602 horses and 169 ponies.

RENOVATED-BUTTER INSPECTION.

The inspection of dairy products under the act of March 2, 1902, was continued. Repeated inspections were made of 82 renovated-butter factories, located in 17 States, and the quantity of butter made by these was 54,656,800 pounds. This was an increase of 9 per cent over the previous year.

BUREAU OF PLANT INDUSTRY.

The work of the Bureau of Plant Industry has been pushed with vigor during the year. The advances made and the suggestions and recommendations for future work are set forth under the accompanying headings, and are believed, in all cases, to be for the betterment of agricultural conditions in the United States.

COOPERATION WITH THE EXPERIMENT STATIONS.

The Bureau is cooperating now with more than forty State experiment stations along many varied lines. The improvement of forage crop conditions, the extension of the work on cereals, the testing of new seeds and plants from home and abroad, demonstration work in the treatment of plant diseases, etc., are some of the more important problems upon which the stations are contributing to the Bureau.

THE DISTRIBUTION OF SEEDS AND PLANTS.

As set forth in my last report, a number of changes have been made in the securing and distributing of seed for Congressional purposes. Instead of contracting for all the seed and having it put up by one firm, the Department has purchased the seed and arranged for the putting of it up by contract. This is a great improvement over the old method, as it practically removes all opportunities for difficulties which have been encountered in the past in the matter of substituting inferior seeds for those called for, giving short weights, etc. With the enormous amount of seed that has to be purchased in the Congressional distribution, it is impossible to make provision in advance for everything that will be required. If seed were a fixed commodity it would not be difficult to make specific contracts for the delivery of particular quantities at particular times. So much, however, depends upon weather and other conditions that it can never be determined until the harvests are all over as to what seed can and what can not be obtained. For this reason it is not practicable, nor is it desirable, that the Department should endeavor to secure its seed by the ordinary contract system. Inferior seed can so easily be substituted for good that the Department must devote special attention to this phase of the subject in order that nothing but the best may go out.

To accomplish this, seed, for the most part, must be purchased in the open market from men who are known to be reliable and in whom dependence can be placed for furnishing seed according to contract. To protect the Department in all of its interests, inspectors are kept constantly in the field during the growing season looking after the crops that are being grown for the Department and in other ways keeping track of the seed conditions in general, so as to be intelligently guided

in the matter of purchases. Furthermore, the Department, by judicious placing of orders for seed, can encourage home industries. This it is endeavoring to do in every case where it is practicable. In a number of instances, where certain kinds of seed are grown to a large extent abroad, the Department has placed its orders with American growers in order to encourage the work in this country. This is particularly the case with flower seed, of which a number of kinds are now being specially grown for the Department on the Pacific coast and elsewhere.

Carrying out the plan as set forth in my last report, special attention has been given to particular crops, such as cotton, forage plants, and other crops. In the matter of cottons an effort has been made to secure for general distribution varieties which have come to the attention of the Department's officers as valuable sorts, but of local distribution only. The work in this connection has been exceedingly valuable, and many reports have been received as to the greater usefulness of the varieties distributed over those locally grown. The same is true of a large number of forage crops. A particular effort has been made in the matter of distributing home-grown sugar-beet seed. It has been found that sugar-beet seed can be grown successfully in this country, and that the beets from such seed yield a high sugar content. Ten thousand pounds of such seed were distributed last year, and careful work was inaugurated to determine the value of the product from these seeds as compared with seed grown abroad.

With regard to the securing and distributing of miscellaneous garden and flower seed, the fact remains that this work does not accomplish the ends for which the law was originally framed. There are collected, put up, and distributed now, on Congressional orders, nearly 40,000,000 packets of miscellaneous vegetable and flower seeds each year. These seeds are the best that can be obtained in the market, but from the fact that large numbers of packets are wanted, the seed obtained can be of standard sorts only, such as are to be found everywhere for sale in the open market. As there is no practical object to be gained in distributing this kind of seed, it seems very desirable that some change be made. To this end, it would seem wise to limit our work entirely to the securing and distributing of seeds, plants, etc., of new and rare sorts. There is still much to be done in the way of securing seeds, plants, etc., of this kind from abroad, but still more to be accomplished in careful investigations of our own possibilities in this direction. There are many valuable plants scattered all over this country which are still little known outside of their respective localities. These should be collected, tested, and distributed. There are also great possibilities of improving agricultural industries by distributing specially bred seeds and plants.

As the plant-breeding work of the Department increases, opportunities for securing seed of this nature will accumulate. To do this work in the most effective manner, arrangements could be made in all cases to secure the advice and assistance of Senators and Representatives who have agricultural constituents. The Department has a well-organized force of scientists who are thoroughly familiar with the general conditions of soil and climate in nearly all parts of the country. Special crops could be selected for special purposes, and with the advice and cooperation of members of Congress such crops could be placed where they would do the most good. This is a line of work that would result in very much more value to individual districts throughout the country than the distribution of a large quantity of common varieties of garden seed, which have no particular merits so far as newness or promise are concerned. I shall inaugurate the coming year work along the lines here mentioned, and hope to receive the cooperation and aid of Congress in this matter.

NEW SEEDS AND PLANTS FROM ABROAD.

During the past year the seeds secured by our agents in Asia and Africa, to whose explorations reference was made in my last report, have been received and distributed. Special attention was paid this year to the reorganization of the work within the United States. It was felt that the time had come for more thorough work within this country, since there were many introductions that had not been pushed as they deserved to be. The clerical force was therefore strengthened, and a systematic attempt was made to secure reports from persons who had received seeds and plants. Many of these reports are now on file, and the work of compiling them to make them useful in further work is going on.

GRAINS.

Special attention has been given the grains. New wheats for the Northwest, new oats, new millets, and other crops have been pushed. The work on durum or macaroni wheats has been highly successful. Probably 10,000,000 bushels of this class of wheat were harvested in the crop of 1903. The value of macaroni wheats in the drier portions of the Great Plains is now fully established, and the demand for them is increasing as their value becomes better known. The quality of the wheats is always better in the drier areas, and in general they are not adapted to the ordinary spring and winter wheat districts. Where there is sufficient rainfall for good crops of spring and winter wheats, macaroni wheat should not be grown; especially as it is likely to be inferior in quality to such wheat grown in the drier regions, and could not, under such conditions, bring a price equal to that of the ordinary

grades of spring and winter wheats or the better grades of macaroni wheat. There is a constant foreign market sufficient for a good export trade, as soon as the business can be facilitated by opening up the proper trade channels, but the home demand at the local mills is most important and is rapidly increasing. At least 20 mills are now handling this wheat, and there may be others not yet known to this Department. At an average capacity, these mills, running half time on macaroni wheat, would consume between 3,000,000 and 4,000,000 bushels during the year. A large part of the product is in the form of semolina, which is now being used by eight to ten of the most important macaroni factories in the country, all of which had formerly used ordinary bread flour, and a number of which will hereafter use only the semolina from macaroni wheat.

Tests have been made during the year, first by private institutions and some of the experiment stations, and then by the Department, to determine the value of macaroni wheat flour for bread. The results appear to show that a very good quality of bread can be made from such flour. After a number of preliminary experiments by the Department a test was finally made in which 200 loaves, made from macaroni wheat flour, were compared with an equal number made from the highest grade of spring wheat patent. Selected experts among the millers, bakers, flour inspectors, grain dealers, and teachers of domestic economy throughout the country stated their opinions in writing as to the relative merits of the two breads. A consensus of these opinions showed that in this experiment, at least, the macaroni flour made a fine quality of bread.

ALFALFA.

The Turkestan alfalfa seed secured by our agent in Asia was distributed through the active cooperation of members of Congress. This distribution was made in such a way that it would result in a supply of home-grown seed being available in the future, so that we may avoid the expense and uncertainty attending the importation of the seed. Reports received up to date indicate that many of the plantings made have been successful, and there is reason to hope that this valuable variety has been permanently introduced into the United States.

Of especial importance will be the introduction of an alfalfa adapted to the alkali parts of our arid Southwest. Work on this problem has been pushed forward during the year. The seed secured by our explorer in Algeria, as well as some sent by our representative from Turkestan, has been planted under the personal supervision of the Department experts. There is reason to believe that this introduction will be successful, in which case it will be possible to reclaim large areas of land in the Southwest that are now too alkaline for alfalfa.

RICE.

The rice work done during the past year demonstrated the very important fact that by the use of proper varieties it is possible to materially extend the period of harvest. This has all along been one of the serious difficulties which the growers have had to encounter, but by the use of varieties which the Department has introduced it will be practicable to sow large tracts and to harvest as the different varieties ripen, without haste and without loss.

FLAX.

The cultivation of flax is one of the oldest agricultural industries in the United States, but it has been forced to move steadily westward to new lands, as it became unprofitable in the older States. It was thought that flax exhausted the soil and could thus only be grown for a few years in one locality, but recent research has shown that the real cause of "flax-sick" land is a disease, the germ of which, living over in the soil, soon makes it impossible to produce flax where this disease is prevalent. The importance of the industry to our Northwestern States may be judged when it is known that in 1901 the State of North Dakota alone produced $19,460,000 worth of flaxseed. To this must be added the growing industry of using the fiber of the seed flax for making binder twine and other coarse materials. This industry is seriously threatened by the same disease that has forced flax culture to move out of the Eastern States, and the Department has sent an expert to Europe in the hope that in some of the provinces of Russia a variety resistant to this disease might be found. In any event, it will be possible to secure better varieties than we now have and to learn how the farmers of Europe have managed to hold this disease in check.

NEW LINES OF WORK IN SEED AND PLANT INTRODUCTION.

Among several new introductions designed especially to meet the needs of the Southeast have been improved varieties of cassava, which give promise of great value for stock-feeding purposes and starch making; superior varieties of mango for cultivation in the extreme South, and Mexican peaches and apricots which, it is thought, will be better adapted to cultivation in the South than the varieties we now have. A number of plants of a choice variety of pineapple were also received from South Africa through the generosity of Hon. Barbour Lathrop.

Work has also been begun on the establishment of the matting industry in the United States. At present matting to the value of nearly $5,000,000 is annually imported. A loom has been perfected for weaving the material, and the Department has undertaken the establishing of the cultivation of the raw material.

The Department annually receives many hundreds of packages of seeds and plants from abroad. These are all being carefully tested, and as fast as any give promise of value they will be propagated for further distribution.

The lines of work here enumerated are capable of great extension, and will result, as experience has already shown, in building up new industries of great importance to the country.

DRY-LAND AGRICULTURE.

Nearly one-third of the area of the United States has insufficient rainfall for the best culture of the ordinary crop plants. Considerable tracts of land are already irrigated and much more will be artificially watered in the future; but there must eventually remain enormous areas—doubtless nearly a fourth of the entire land surface of this country—which are doomed to remain perpetually in their present arid or semiarid condition for the want of an adequate supply of water for irrigation. The total rainfall over the lands lying between the one hundredth and one hundred and twentieth principal meridians is inadequate to irrigate more than a small fraction of the arable lands, no matter how carefully conserved and used. Dry farming is then a necessity, in order to utilize such lands where irrigation can never be practiced.

The Bureau of Plant Industry is occupying itself with the future of these regions, and is making a thorough study of the conditions and of the best ways and means of meeting them.

It is believed that not only can the grazing capacity of such lands be increased by intelligent management, but that large areas of such dry, but often extremely fertile, lands can ultimately be utilized for "dry farming." It is believed that as the irrigable lands become more and more completely occupied, there will be an increasing appreciation of the value of, and a greater effort to utilize, the dry, unirrigable lands adjoining settlements founded in the irrigated regions. In the meantime the scientists of this Department are endeavoring to secure plants that will grow in very dry soils, and at the same time yield paying crops that can be absorbed by our markets or profitably utilized on the farm. To carry out such introduction of new crops it is necessary to study most carefully the life history of each particular plant, in order to determine with some degree of accuracy its needs as to climate and soil, also its cultural requirements and the best methods of marketing or otherwise utilizing its products. It is only by carrying out in advance a life-history investigation in the most scientific way that it will be possible to introduce such new crops into profitable culture on a commercial scale without running the risk of most costly and discouraging failures.

To extend this important work a small increase in the appropriations has been included in the estimates of this Bureau.

NITROGEN-FIXING BACTERIA.

The fact that leguminous crops, like peas and clover, can obtain nitrogen directly from the atmosphere when certain bacteria are present on the roots has been known for a long time, and many attempts have been made to cultivate and use these bacteria in agricultural practice. Attention has been called in past reports to the progress the Department has made in investigating this problem. At the time of the last report the reason for the failure of former work from a practical standpoint, both in America and in Europe, had been determined, and a new, simple, cheap, and thoroughly satisfactory method of cultivating, distributing, and using these nitrogen-gathering organisms for all important crops had been perfected. During the past season the value of these bacteria has been demonstrated in extensive field tests. Good stands of clover and alfalfa, vetch, cowpeas, etc., have been secured in soils where, without the bacteria, these crops were a failure. The field work also demonstrated that soil and seed inoculation are equally valuable, so that either method may be used according to convenience. As a result of these experiments the Department is now prepared to furnish, in reasonable quantity, organisms for all the principal leguminous crops. Patents have been applied for, covering all the processes used, in order to make them secure for general public use. To enlarge the scope of this work and to carry on the necessary field demonstrations, an increase in the funds of the plant physiological and pathological investigations has been included in the estimates.

WATER CONTAMINATION BY ALGÆ.

It is well known that algæ of various kinds play an important part in the contamination of water supplies. The bad odors and tastes which some varieties of these plants give to water make it unpalatable to stock as well as to man. Some of the algæ also smother out aquatic crops, like cress, and furnish breeding places and food for mosquitoes. The physiologists of the Bureau of Plant Industry have now developed a cheap and effective method of exterminating algæ, which promises to be of universal application, in reservoirs, lakes, ponds, etc., where algal pollution exists. Extensive tests are now being carried out in cooperation with various board of health and water engineers, and the results so far have been extremely satisfactory. When the tests have been completed a full report will be issued and the method fully disclosed.

NEW LONG-STAPLE UPLAND COTTON.

Attention was called in the last report to the fact that the plant-breeding experts had secured some hybrid long-staple Upland cottons which promised to be of great value. These are of the ideal type desired, having large bolls, very productive, with long, fine fiber, about 1¼ and 1⅜ inches, borne on smooth black seeds. Preliminary field tests of the varieties have now been completed, and several of the best appear to be already fixed in type and come true by seed. Extensive field tests are under way, and if the results of the present season's work are satisfactory seed will be grown for distribution. Much attention has also been given to the improvement of the ordinary Upland types of cotton by straight selection. Many growers have become interested in this work, and appreciate the value and importance of careful selection of seed.

EGYPTIAN COTTON.

Another important line of work which is receiving considerable attention at the hands of the Physiologist and Pathologist is the introduction and establishment of the best varieties of Egyptian cotton. We now import annually about $7,500,000 worth of these cottons, and the demand is rapidly increasing. When first introduced, most of these varieties gave comparatively light yields, and in some cases the fiber apparently lost some of its essential characteristics. These difficulties, however, are gradually being overcome as the result of careful selection and breeding. Samples of fiber grown last year in experiment patches have been submitted to experts in this country and Europe, and several of them have been pronounced equal to the best Egyptian. Manufacturing tests are now in progress. The indications at the present stage of experiments favor the belief that we shall soon have varieties adapted to cultivation in this country. The tests are in progress in Georgia, South Carolina, Mississippi, Texas, New Mexico, Arizona, and southern California.

DISEASE-RESISTANT COTTONS.

Great interest has been manifested by planters and handlers of cotton in our work of securing disease-resistant strains or varieties. The wilt-resistant Sea Island varieties distributed by the Department last year and this year have proved highly satisfactory. Wilt-resistant Upland strains have now been developed and are being grown on a large scale this season for the production of seed. Growers in all parts of the cotton belt where wilt occurs have adopted the method of resistant-seed selection recommended by the Department. In infected land the ordinary sorts are a complete failure, while the resistant varieties produce a good crop. Considerable progress has also been made in

selecting varieties resistant to Texas root rot, the boll-weevil, and other serious pests.

DISEASES OF SUGAR BEETS.

The work on sugar-beet diseases was continued during the year. The spraying experiments with Bordeaux mixture for the control of leaf blight were entirely satisfactory in holding the diseases in check, and resulted in an increase of approximately 50 per cent in the tonnage. Further investigations were also made of the disease known as curly top, which was prevalent last year and has been even more serious the present season. So far we have been unable to determine the cause of this malady, but there is hope of securing strains resistant to the disease. A small increase in the appropriations for this work has been put in my estimates.

DISEASES OF ORCHARD FRUITS.

The work on diseases of orchard fruits for the past year has been largely in the nature of demonstrative experiments, the idea being to show the practical growers how to put into operation the various methods of fighting disease. Especial attention has been given to little peach in Michigan and New York. In the former State, in cooperation with the State authorities, the disease has been stamped out of a large area. The principal work in pear blight has been carried on in Georgia. In the north Georgia experiments the treatment was entirely successful, the disease being eradicated from the experimental orchards. In the south Georgia experiments, while the disease was not completely eradicated, the treatment greatly improved the condition of the orchards as compared with the surrounding untreated orchards. From the large field experiments in the past two years the Department now feels certain that bacterial blight of pears and apples can be controlled if the treatment recommended by the Department is carried out thoroughly. Similar demonstrative work will be done in some other pear or apple section the coming season.

DISEASES OF TRUCK CROPS.

The intensive culture of vegetables for home and foreign markets has developed to great proportions in the United States. Wherever crops are grown on an extensive scale the appearance of a disease becomes a serious matter, and often the cause of great loss. In nearly every important truck section serious diseases have appeared, and wherever they have been called to the attention of the Department an effort has been made to determine the cause, and if possible to suggest a remedy. The loss to the cucumber growers in the South Atlantic trucking regions and in the Mississippi Valley was heavy this year,

owing to the prevalence of bacterial wilt and downy mildew. Information was furnished to the growers relative to the means of controlling these two diseases. Considerable work was also done with watermelon, tomato, and cabbage wilt. The only way to control these wilt diseases is by the use of resistant varieties. In the case of the watermelon, the citron and some foreign melons have proved to be wilt-resistant, and hybrids between them and the native varieties were also resistant and immensely productive. An endeavor is being made to fix a type of these hybrids. We have also succeeded in obtaining resistant selections from American varieties. With tomato and cabbage a similar line of work has been started, with promise of success. Further tests of the variety of cowpeas known as "Little Iron," resistant to wilt and root knot, have been made during the year, and even in the worst infected soils this variety has proved perfectly resistant. It has been crossed with heavier yielding varieties, with the hope of obtaining improved strains.

CALIFORNIA VINE DISEASE.

Attention has been called from time to time to the progress that has been made in efforts to find a method of controlling the California vine disease, a malady the cause of which still remains unknown. Experiments with grafting stocks have been in progress in the center of the badly infected district for over eight years. These experiments have included the grafting of some 400 acres of vines, the enterprise being conducted in cooperation with leading viticulturists in California. The Lenoir vine is resistant to the disease, and its use either as a top graft or as a root upon which to graft other varieties has been found effectual in resisting the disease.

New varieties of grape, which have received Lenoir blood through hybridizing, have shown great resistance to the same disease.

So far as this experiment has gone, therefore, it seems probable that a satisfactory means of permanently overcoming the disease has been found.

TIMBER PRESERVATION AND SEASONING.

The work of timber preservation and seasoning has been conducted by the cooperation of the Bureau of Plant Industry and the Bureau of Forestry. The saving caused by improved methods of cutting timber to insure longer life has already been very great. In one instance about $50,000 was saved in six months. Extensive tests were carried on in cooperation with railway, telegraph, telephone, and mining companies, to determine the amount of water evaporated from timber. Drying out timber according to methods suggested by the Department has led to a great saving in freight and increased length of life of the timber,

besides resulting in a saving of labor in handling it. Various preservative processes have been tested during the year, and considerable advance has been made in this art as the result of the Department's investigations. Our aim is to secure a process which will be so cheap and effective as to make it within the reach of even the small user of timber.

WORK WITH MUSHROOMS.

An industry of considerable importance has sprung up in this country in the growing of mushrooms for market; but so far it has not reached great proportions, owing to the fact that most of the spawn has to be imported. We also import in the shape of canned mushrooms about 2,300,000 pounds annually, principally from France. There is no reason why this important food plant should not be grown here to a sufficient extent to cover all our needs. One of the greatest difficulties of mushroom growers, both in this country and in Europe, has been the uncertainty of growing a productive spawn of high vitality, and so far practically only one variety of mushroom has been cultivated commercially. The Department has now discovered a simple and practical method by which we have produced a high grade of spawn, not only of the cultivated mushrooms, but of many of the wild sorts which it is desirable to cultivate. The perfection of a simple and effective method of propagation, as above stated, applicable to all varieties of mushrooms, is probably the most important step in mushroom culture that has ever been made.

DRUG AND MEDICINAL PLANTS.

The extensive importations of crude drugs, amounting to more than $3,000,000 annually, have led to many attempts to cultivate drug plants in this country. In most instances this work, entered into by persons who were without adequate information in regard to the conditions required, has resulted in discouragement and loss. Experiments undertaken by the Botanist to determine the actual cost of producing, curing, and preparing for market certain kinds of crude drugs, especially leaves of plants like stramonium, indicate that they can not be produced profitably unless they may be grown where land and labor are cheap, and where the growing season is long. An experiment in curing the leaves with artificial heat gave very promising results, and if this method proves to be entirely satisfactory a great saving in time and labor will be accomplished in this part of the work, with the assurance of greater uniformity in the product.

The cultivation of golden seal, seneca snakeroot, and other similar native drug plants that are becoming exterminated in the wild state, has been begun on a small scale, to secure definite knowledge in regard to their life habits and to determine the conditions under which they

may be cultivated. Owing to the increasing demand for them and their rapid disappearance from the forests, their successful domestication is extremely desirable.

POISONOUS PLANTS.

The important results from the poisonous-plant investigations conducted by the Botanist in previous years have been followed by an increased demand for further work along this line. The annual loss of sheep from eating poisonous plants on the ranges of the Northwest has been estimated to exceed $400,000. There are also very considerable losses among cattle and horses on the Western ranges, due to death camas, loco weed, and other poisonous plants. Besides a large amount of miscellaneous work in this direction, with the accumulation of important information in regard to various kinds of poisonous plants, special investigations have been made with two important groups—death camas and the lupines.

The excellent lupine forage, which has been avoided by many stockmen because they lacked knowledge of the character of its poisonous properties, may be utilized, providing certain precautions are regarded. Sheep must not be allowed to eat freely of lupines when coming hungry and thirsty from a dry, barren range. Some other food, preferably of a succulent character, and a plentiful supply of water should be given to animals grazing on lupines.

FIBER PLANTS.

The importation of vegetable fibers amounts to more than $30,000,000 annually, and the quantity is continually increasing; yet it is scarcely sufficient to meet the demands of our increasing cordage and textile industries. There are areas in this country where soil and climatic conditions are as well suited to the growth of flax and hemp as anywhere in the world; yet nearly all of the flax fiber and more than half of the hemp fiber used in our manufactures is imported. To compete successfully with the foreign product, our farmers must produce a fiber of equal or superior quality at a relatively low cost. The first requisite for superior quality of fiber is an improved variety of the flax or hemp plant. With this object in view, seeds of improved foreign varieties are being imported, and selections of seed are being made from American-grown plants. Reduction in the cost of producing the fiber must be brought about mainly by the introduction of improved methods of handling the crops and the substitution of machinery for the large amount of skilled hand labor which has heretofore been regarded as necessary in the preparation of the fiber. Carefully conducted experiments are needed to demonstrate the practicability of new methods that will reduce the cost of production.

IMPROVEMENT IN MANILA FIBER.

Manila fiber is the strongest and most important material used in the manufacture of the better grades of cordage. With a greatly increased demand during the past five years, and consequent high prices, a tendency arose among Philippine producers of manila fiber to sacrifice quality for quantity. Importations showed carelessness in preparing and in grading the fiber, a condition that threatened serious injury to the market for this, the most important product of the Philippine Islands. After careful examination of the fiber in the bales as imported, a report was forwarded to the Philippine government, by whom immediate action was taken and a thorough investigation made of the production of manila fiber in the field and its preparation for export. A law has been drafted by the Philippine government regulating the methods of cleaning the fiber, and also to provide for inspection of fiber to be exported. The higher standard of quality and the uniformity of grade assured under this law will not only result in great satisfaction to the manufacturers and users of manila cordage, but it will tend to still further increase the market for this most useful fiber.

GRAIN-GRADING METHODS.

The inspection and grading of grain, which is a prominent feature of our grain business, has been the cause of some apparently well-founded dissatisfaction in both our domestic and foreign trade. The chief cause of this has been that grain inspectors have had, as a rule, no adequate means of educating their judgment, upon which they must rely for the greater part of their work, and the inspection departments have had no very satisfactory apparatus for settling disputed or appealed cases. During the past year the Department has developed an apparatus for determining the moisture content of grain, particularly corn. This apparatus, essentially an air bath and a delicate balance, enables any inspector or warehouseman to determine the condition and probable keeping quality of corn; since excessive moisture is the principal cause of deterioration in this cereal.

Methods of accurately measuring essential qualities and defects of any sample of grain are a necessary preliminary to a satisfactory system of grain grading. The Department is, therefore, endeavoring to learn what these essentials are for each class of grain and how they can best be measured, so that grain inspectors may have available the means to do their work with the highest possible degree of efficiency.

The general adoption of such methods is likely to be of great benefit to the grain trade, as it will naturally result in greater definiteness of rules for grades and more uniform work by inspection departments.

FOREIGN COMPARED WITH DOMESTIC CLOVER SEED.

For the past two years cooperative work has been carried on between the Bureau of Plant Industry and several of the agricultural experiment stations to determine the relative value of foreign and domestic red clover. The seed raised in this country has given a larger yield of hay, though one sample from Russia gives promise of a good yield in the northern tier of States. Experiments will be undertaken to determine the relative feeding values.

TYPE LOCALITIES AND CHANGE OF SEED.

The work done on foreign and domestic clovers shows that there is a marked effect on general thriftiness, yield, and earliness when seed from one locality is sown in another where it is subjected to different conditions of climate and soil. Under the present methods of handling in this country, the seed is all brought together at the large market centers, where it is bulked and graded according to appearance, without regard to place of growth. This seed is then distributed to the small dealers throughout the clover-growing area. While the indiscriminate mixture and change of seed resulting from this method of handling may prove beneficial in some cases, it is often undoubtedly a distinct disadvantage.

The seed of all of our grass and forage plants, as well as much of our vegetable and grain seed, is produced under similar conditions, thus preventing any knowledge of origin or special adaptability.

A thorough study should be made of our principal crops to determine the type or best locality for seed production, as well as the advantage or disadvantage of changing seed from one locality to another, and the limits within which this should be done.

A study should also be made of both the foreign and domestic seed production of the crops of which we now import large quantities, so that the domestic production may be aided and encouraged as far as possible.

DEMONSTRATION WORK WITH FORAGE CROPS.

The office of Grass and Forage Plant Investigations has put in the field a number of agents, whose duty it is to visit farmers in sections where forage plants are needed and arrange with them to grow a small area of some crop which is known to be valuable in that section. In this way much interest has been created in crops which were new or comparatively so, particularly in the cotton-growing States. As a result of this work, there is now a decided movement toward a diversified system of farming.

In addition to the above, a number of small demonstration farms have been established, on which various grasses and forage plants are grown

under the direct supervision of officers of the Department. These farms are visited by large numbers of farmers who by this means acquire an interest in the crops and some knowledge concerning their cultivation and utilization. In other words, new and valuable crops are being rapidly introduced into many sections of the country where greater diversification of crops is needed.

WILD HAY.

In 1899, 15,457,000 acres of wild grasses were cut for hay in this country. During the present season the grasses thus utilized have been studied with a view to ascertaining their relative agricultural value. Much important information has been gained, and some of these grasses have been found which possess characteristics that will enable us to bring them into cultivation, particularly in the arid and semiarid regions of the West. We are now gathering considerable seed of four or five of the most important, with a view to introducing them on cultivated land.

LEGUMINOUS CROPS.

One of the most important movements which has occurred in American agriculture is now in progress. It is the general introduction of alfalfa as a hay and pasture crop. During the present season good crops of alfalfa have been grown by our experimenters in almost every State in the Union.

Other leguminous crops are receiving a large share of attention. The Department has secured some seventy-five varieties of soy beans, and has grown them for two seasons with a view to finding varieties adapted to different climatic conditions. Within another year we shall be ready to begin the introduction of a number of the best varieties. Varieties have been found adapted to practically all parts of the country.

The cowpea continues to receive a large share of attention in our demonstration work. We are attempting to add largely to the acreage of this important crop in the cotton States. Varieties have been secured adapted to the Northern States as well.

A number of new legumes have been secured and are being propagated with a view to obtaining seed for introduction work in the near future.

RANGE INVESTIGATIONS.

Fifty-eight square miles of typical range land near Tucson, Ariz., have been put under fence during the year. Careful studies are being carried forward on this area, with a view to determining the result of protecting the now exhausted range from the depredations of stock. In the State of Washington we have demonstrated that the mountain

ranges may be restocked with grasses by using seed. Our investigations have also shown that the ranges in that section may be so handled as to largely increase their productive capacity; but in order to do this it is believed to be demonstrated that it is necessary for those who graze stock upon the ranges to control a definite area of range land.

SOIL AND SAND BINDERS.

A representative of the office of Grass and Forage Plant Investigations during the past season studied the extensive work on soil and sand binding that has been done in Europe. After two hundred years of experience in Europe it has been shown that drifting sand can be controlled. Work has been undertaken with this end in view at The Dalles, Oreg.; Astoria, Oreg.; on the eastern shore of Lake Michigan, and at several points on the Atlantic coast. In many places these drifting sands have covered up extensive areas of valuable farm land. In other cases they have encroached upon cities, and have even buried portions of them. In still others they have interfered seriously with railroad traffic.

CASSAVA.

Studies by agents of the Department have shown that the cassava crop is of great importance in the region adjacent to the Gulf as a feed for cattle and hogs. This crop has been grown in a desultory way in Florida for nearly half a century. The value of the crop has been known, but there have been two principal difficulties in the way of its cultivation. The first is that it is propagated from sections of the stalk, and these are very difficult to keep during the winter season. Growers have now been found who have apparently solved this difficulty, and a number of the best methods of keeping the seed stems will be tested on a large scale by the Department this winter.

The other difficulty relates to securing a stand. It has been demonstrated that it is practicable to sprout the cuttings in hotbeds and transplant them into the field afterwards, and in this manner to secure almost a perfect stand, thus doubling the average yield. Arrangements have been made to give this method a thorough trial next season. The importance of this work will be better understood when it is known that an acre of cassava yields as much food value as 8 to 10 acres of corn in the section where cassava is grown.

POMOLOGICAL INVESTIGATIONS.

In no other country in the world has fruit culture attained such large proportions as in the United States. Favored with a broad range of latitude, affording great variety of soil and climatic conditions, there are but few fruits of the temperate zone that are not now produced on a commercial scale within our borders. The track of the pioneer has everywhere been marked by the planting of orchards and vineyards.

In certain regions the production of fruits and their products has become the chief feature of agricultural life, and the welfare of the people therein is largely dependent upon the successful production, harvest, and sale of such fruits as the peach, apple, grape, orange, and several others. In all such regions the question of adaptability of types and varieties to soil and climatic conditions, and their suitability for the purposes for which they are to be used, becomes a most important one from the economic standpoint. Unlike the grower of grain or vegetables, the orchardist or vineyardist must invest years of time and labor, in addition to the original outlay for land and stock for planting, before his plantation attains sufficient age to begin to yield a return. It is therefore of the utmost importance that there should be accessible to him information regarding the distinct characteristics of fruit varieties, their particular requirements as to soils and climate, their times of ripening, and suitability for particular uses, such as shipment to distant markets, use in canning, drying, preserving, etc. One of the important duties of the Pomologist and the force engaged under him is to accumulate and interpret the results of individual experience along these lines throughout the country, so that it may be furnished to the interested public in convenient form for their guidance in fruit culture.

FRUIT MARKETING AND STORAGE.

Some of the most pressing and important questions relating to the fruit industry are those that grow out of the present tendency in horticulture to produce each fruit in that section where it can be grown best or to mature at a certain desired time, even though that locality be thousands of miles from the market where the product will be consumed. These problems may be characterized as those relating to marketing and storage. Their solution lies at the foundation of development of important export trade in fruits, and is hardly of less moment in connection with that portion of the crop which is used at home.

Some of the questions involved are with regard to the best methods of harvesting, grading, packing, and transporting each fruit, with reference to accomplishing its safe and economical delivery at its desired destination; also with regard to the suitability of the variety, packing and package, to the needs of the consumers, who are to be the purchasers if profitable trade is to be built up. These questions are of especial importance in connection with the export trade, and a series of experimental shipments is being made to obtain light upon these points.

Through these experiments, which have been conducted on a commercial scale, chiefly through the ordinary channels of trade, it has been demonstrated that the Bartlett pear, a choice but perishable

fruit, of which there is frequently so large a surplus in our Eastern States as to depress prices to a point where the producer receives little return for his labor, can be successfully and profitably shipped in refrigeration across the Atlantic and sold at prices that yield a good net advance over home value.

Elberta peaches from Georgia and Connecticut, and several varieties of summer apples from Delaware, can be landed in London in prime condition when the climatic conditions at time of shipment are favorable; and they are likely to meet with good demand at fair prices.

It is gratifying to note that commercial shippers are following the work of the Department along these lines with keen interest, and preparing to make extensive shipments of such fruits as are found capable of profitable handling in this way.

A notable event of the year was the inauguration of direct shipments of American winter apples to Paris through the instrumentality of the Department. As was anticipated from previous investigations made by the Department, russet varieties were found to have preference to red apples in that market, and where sound and free from blemish were in good demand at high prices. The opportunity to develop trade in this line appears excellent.

Numerous and comprehensive tests of other fruits are under way, and may be expected to yield decisive results in due time.

The storage of fruits at low temperatures to retard their ripening and decay for a sufficient time to permit them to be handled to the mutual advantage of the grower and the consumer has assumed very large proportions in this country, chiefly within the past decade. It has been demonstrated beyond question that all fruits destined for preservation in cold storage should be stored quickly after removal from the tree; a uniform temperature of 32° retards the ripening processes of apples, pears, and peaches more than higher temperatures, without any noticeable injurious effect upon their flavor. It has also been demonstrated that certain delicate fruits, like the Bartlett pear and the peach, which ripen in hot weather, require quick cooling after entering the storage room, and that this can probably best be accomplished by storing in small rather than large packages.

STUDIES OF GRAPES AND GRAPE GROWING.

In addition to continuing the work of thoroughly testing the large number of varieties of European table grapes in the cooperative experimental vineyards in North Carolina and Florida, a comprehensive investigation of certain viticultural problems relating to the vine industry of the Pacific coast has been started.

The rapid and extensive development of grape culture in California is one of the most striking features of our fruit industry. Based

almost exclusively upon the European grape species, as it is, vineyard methods modeled after those of the Old World are more successful there than in the vineyard regions of the Eastern States, where the native species of grape are the main dependence. The fertile soil and favorable climatic conditions in California have in general resulted in large yields and good profits to the grower.

Certain serious difficulties have arisen, however, which require immediate attention. Among these may be mentioned the general infestation of the important vineyard sections with the destructive Phylloxera, which preys upon the roots of the European grape. The general principles of the method of combating this insect through the use of resistant stocks have been demonstrated by entomologists, but the practical application of these involves many important vineyard problems which properly fall to the viticulturist. Among the most important of these is the relative adaptability of the known resistant stocks to the leading vineyard soil types and the congeniality of the principal commercial varieties of foreign grapes to these resistant stocks.

In cooperation with the California Agricultural Experiment Station and the office of Seed and Plant Introduction of the Bureau, experimental vineyards have been established at Fresno and Oakville in connection with this work.

WORK AT THE ARLINGTON FARM.

APPLES AND PEACHES IN NURSERY.

There are now growing in the nursery some 400 varieties of apples, the scions of which have been secured from bearing trees known to be true to name. The peach list embraces 150 sorts chosen with equal care. These collections have been carefully selected to represent the sorts now commercially grown in the several important apple-growing regions of the United States, together with a carefully chosen collection of varieties which show promise of becoming additions to the commercial list.

The aim of these plantations is that they shall form a basis for the comparative study of varieties when grown under like conditions, in order that the influence of climate on horticultural varieties may be observed, to afford basis for taxonomic studies upon cultivated varieties, and to furnish fresh fruits for comparative studies and identification of varieties, as well as material for further extending physiological studies upon the keeping of fresh fruits in artificial storage.

ORNAMENTAL TREES IN NURSERY.

The nursery at present contains several thousand seedling oaks, ashes, and maples, which have been grown from seeds gathered from

trees of note in the District of Columbia. These trees, if sent to schools, parks, and other outdoor improvement organizations of the country, will prove objects of interest, and will be appreciated because of the sentiment attaching to the place of their origin.

EXPERIMENTAL FRUIT PLANTATION.

A further fruit plantation upon the Arlington Farm, consisting of 1,000 trees, is designed as a basis for studying the physiological action of the various insecticides and fungicides upon the health and longevity of trees.

CRANBERRY PLANTATION.

A small typical cranberry plantation is being established upon the farm, in order to determine the adaptability of the plant to the climate and the lowlands lying along the streams of eastern Virginia and Maryland. There are many thousands of acres of land now lying idle that might be made remunerative by the introduction of this crop if it proves suited to the conditions.

ARBORETUM.

An area of some 30 acres adjacent to the buildings which are in course of construction upon the farm is being prepared as an arboretum, in which will be arranged in an instructive, as well as artistic, manner all the native and exotic trees and shrubs which can be grown here. One of the chief reasons for beginning this line of work upon the Arlington Farm is that in this latitude there is an overlapping of the Northern and Southern floras of the United States, which allows the successful growing of a much greater range of species than can be cultivated either farther north or south.

THE POTOMAC FLATS TESTING GARDEN.

SWEET POTATOES.

An extensive variety collection of sweet potatoes is being grown on the Potomac Flats area. In fact, all of the commercial forms and types of the plant known have been assembled and are being raised, both upon the sandy soil of the flats and upon the clay loam of the Arlington Farm; also at one station in Alabama, one in New York, and three in Ohio, selected to cover the glacial drift soil of Ohio, the glacial drift of New York, and the prairie soil and alluvial river deposit soil of Ohio. The variety collection is designed to afford an opportunity for taxonomic studies, while the growing of the crop upon various soils is intended to give an idea of the influence of soil conditions upon the development and culinary properties of the root.

CELERY.

Celery is receiving special attention. It is being grown under various soil and moisture conditions, from various dates of seed sowing, and under the influence of various commercial fertilizers, in order to learn, if possible, the particular factor in environment which determines pithiness—if it is a question of environment rather than an inherited tendency transmitted by the seed of certain strains and varieties.

EFFECTS OF SHADE ON CROPS.

The physiological effects of shade are so marked and are of such commercial value that the horticultural work of the Department will be extended to cover a test of all truck crops which offer any advantages from being grown in shade. The work of the present season has been largely confined to the use of cloth and slat shades upon celery, cauliflower, lettuce, cucumbers, and radishes. As rapidly as the facilities of the Department will permit, all the truck plants which are grown for leaf production will be submitted to the influence of shade. In connection with this work the atmospheric and soil conditions will be carefully studied, with the hope that the reason why plants behave in a different manner under shade from what they do in the open may be determined.

BEET-SUGAR INDUSTRY.

The beet-sugar industry is developing satisfactorily. In 1896 29,220 tons were made; one year ago 220,000 tons were made. Careful estimates put the crop now being worked up at 260,000 tons. This is a more rapid development than has taken place in sugar making with new conditions in any other country. The future of the crop depends upon the adoption of economic methods in field and factory. The growing of seed in the United States of a superior quality is assured, which will result in much richer beets and better yields than from imported seed that is never first class. Heavier tonnage per acre will come from better farming, and more economy from intelligent disposition of the by-products. The industry is well established.

TEA-CULTURE INVESTIGATIONS.

During the year the work on growing tea has been continued at Summerville, S. C., and a new station has been put in operation at Pierce, Tex. At Summerville further work has been carried on in the testing of new varieties, new machinery, and new factory methods. The work at this point has now reached a state where more attention can be given to the improvement of the teas after being harvested. To this end a number of physiological and chemical studies have been

made of the product at different stages with a view to improving methods of curing and increasing the flavors and aromas of the teas. The new methods and apparatus introduced by Dr. Charles U. Shepard, and used in the manufacture of green teas, have proved most satisfactory. Experiments have been carried on quite successfully in the preparation of tea tablets. These tablets are prepared in a special machine of great power, the result being a firm, polished product, which readily falls apart in boiling water. Improvements have been made in the matter of polishing and finishing the teas, all of which will add value to the American product. Despite the fact that the season has been a very unsatisfactory one for a number of reasons, the yield of tea will probably approximate 9,000 pounds, or about what was raised last year. A favorable season would have given a much larger production.

At Pierce, Tex., cooperative arrangements have been made with Mr. A. P. Borden, who has placed at the disposal of the Department a large tract of land suitable for tea growing, and has arranged to provide buildings and a portion of the labor. The Department has an experienced man located at this station, and is making preparations to put out at least 50 acres of tea the present autumn. It is planned to set out at Pierce at least 100 acres and extend the plantation as the funds permit. The labor question plays an important part in this work, but it is believed that conditions are such in southern Texas that proper labor can be secured without difficulty. Altogether, the tea investigations are in quite a satisfactory condition.

FARM MANAGEMENT.

In my last report I pointed out the work the Department was inaugurating in the matter of farm management. It was there shown that efforts were being made to bring together certain facts relative to the methods of managing farms in certain typical sections of the country, the object being to use this information in improving agricultural conditions where the best processes had not been followed. There is a great deal of valuable work to do in this connection, and there is no question that systematic studies along this line will greatly aid in the advancement of agriculture. In every community and in every section there will be found farmers who are much more successful than others. There are reasons for this, and it is these reasons that the Department is endeavoring to determine, so as to point the way for others to follow along the same successful lines.

Closely associated with this work are the demonstration experiments which the Bureau of Plant Industry is conducting. These have for their object the demonstration of the value of certain crops and certain methods over those which may be in use or existing at the present time. As an example of this kind of work, may be cited what is

being accomplished in the introduction of alfalfa and other important forage crops into the South and sections of the country where such crops have not already been grown.

BUREAU OF FORESTRY.

The object for which the Bureau of Forestry exists is first of all to secure the highest permanent usefulness of the forests in the present and future interests of the country. Among our great industries, the lumber industry now stands fourth in importance.

Lumbering of the forests now standing must go on to supply immediate needs. This has made it necessary to find how to make conservative lumbering profitable, and the great danger has been that the rising price and growing scarcity of lumber would not of themselves bring this about until none but inferior forests should be left on which to practice forest management.

It is a safe assertion, that the lumber interests of the United States recognize to-day as never before that forestry has for them a practical commercial value; that the way is in many cases already open to them to consider conservative lumbering as a definite business proposition; and that this condition has been brought about entirely by the efforts of the Bureau of Forestry to deal with the concrete facts of a problem of National importance. The evidence of its success is not only the cases in which lumber companies have already begun to put into operation its plans, prescribing for particular tracts how to lumber with reference to future production, nor the applications which have been made for similar advice elsewhere, but to the surprising interest in the subject which has lately been evidenced among lumbermen generally.

It is greatly to be hoped that the Bureau of Forestry may not be compelled to let slip this opportunity for an important public service by inability to answer the demands which will be made upon it. Experience has shown its capacity to do this work. The wide knowledge of forest conditions and of methods of operation which it has gathered, and the organization which it has developed, fit it to undertake new problems with a probability of success which can be looked for in no other quarter. In so vast a country as ours, and under forest and economic conditions of such variety, the task of revolutionizing the long-established methods of an industry like the lumber business is one of enormous difficulty. On the ability of the Bureau of Forestry to demonstrate, as fast as opportunity permits, that it is good business for lumbermen to conduct operations with reference to future crops, depends in large measure the success or failure of the attempt to preserve what should be our chief sources of timber supply. The proper equipment of the Bureau for this work is nothing

less than a National duty, and I have recommended that the annual appropriation for its use be substantially increased.

ADVANTAGES OF COOPERATION WITH PRIVATE OWNERS.

In cooperating with private owners the Bureau is not expending public money to benefit private interests. Scientific forestry—that is, enlightened management based on an accurate forecast of what a forest can be made to produce in the future—is impossible without full knowledge of all the forces, natural and artificial, which affect its productiveness. This involves a careful study of lumbering methods on the one hand and of the forest itself on the other. The Bureau has now in its possession as the result of this cooperative work the tabulated results of studies in many States from Maine to California and from Florida to Washington, representing a total of recorded individual measurements in the forest, the number of which would mount to scores of millions.

This vast mass of material has been gathered mainly at the private expense of the owners, who have received the expert assistance of the Bureau. Its possession makes it possible continually to enlarge the field of forestry. It has been secured by making its accumulation go hand in hand with practical results. Every working plan prepared and put in operation has meant both the preservation of a source of National wealth and an addition to the knowledge necessary for the wise use of the public as well as the private forests of the land.

Two considerations must be urged in connection with present conditions. The first is that cooperation is now supplying the Bureau with what it needs for Government work at a less cost than would be required to secure the same result independently. The second is that the speedy introduction of management on private lands is a matter of pressing importance. Forest preservation is necessary in the interest of the public welfare. Forest destruction on a large scale is now in progress. It can be checked only by showing that it is possible to use the forests without destroying them. The Bureau of Forestry is doing this, and there is no other agency which can do it. If the Bureau does not put forth every endeavor to introduce conservative management among private owners, the public interest will suffer.

While it is true that hitherto virtually everything that has been done in this country to introduce conservative management as a paying business has been done by the Bureau, it is far from my wish that the Bureau should continue to control operations for private owners any longer than there is a clear and imperative need. It has already entered on the policy of detaching from its staff competent men to take charge of private operations when called upon to do so, in spite of the fact that it needs the services in its own work of all the trained

foresters it has as yet been able to secure. The Government service, however, is the natural goal toward which most ambitious students of forestry will strive because of the superior opportunities of training which it affords.

SCIENTIFIC INVESTIGATION OF FOREST PROBLEMS.

There is danger that the attention which the work of the Bureau in promoting the actual management of forests naturally receives may obscure the importance of the investigations which it is conducting along other lines. These investigations are largely scientific in scope and method, but always entirely practical in purpose and outcome. The Bureau is the recognized source of information for the country on all forest subjects. The volume of its great and growing correspondence due to this is one evidence of its usefulness. It is conducting experiments along lines which have received the enthusiastic approval of engineers, constructors, and the like, to determine the strength of timbers. It is discovering how to treat cheap woods with preservatives so as to make it commercially practicable to substitute them for more expensive kinds, thus virtually adding new sources of valuable supply. It has inaugurated a new method of gathering crude turpentine which has revolutionized within a single year the naval stores industry of the United States, with an annual output of $13,000,000 worth of turpentine and rosin, whereby the yield of turpentine is nearly doubled with practically the same expense for labor, and the life of the tree which yields the turpentine is greatly prolonged.

In the fall of 1902 this new system had been experimentally in commercial use for a single season on the tract of one operator in Georgia. To-day the men who conduct three-fourths of the operations in the whole Southern pine belt have adopted it, or are waiting to adopt it as soon as their orders for the necessary apparatus can be filled.

FOREST MANAGEMENT.

While the growing willingness of the private owners, in whose hands are the great bulk of the forests of the country, to inquire into the possibilities of forestry in connection with their holdings has opened an opportunity for educational work, the value of which it is hardly possible to overstate, a larger proportion of the energies of the Bureau has been given during the past year to introducing forestry on public lands than ever before.

In accordance with the provisions of the so-called Morris bill, selection has been made and approved of 104,159 acres out of a total of 225,000 acres of land in the Chippewa Indian reservations in northern Minnesota, which will constitute the Minnesota National Forest

Reserve. Official announcement of the second selection will soon be made. Selection of ten sections to be reserved from sale and settlement has also been made and approved. Volume tables and estimates of the total stand of the forest have been prepared, upon which will be based recommendations for the reservation from lumbering of 5 per cent of the timber for seed trees, as the act provides. Trees which will not be cut when the forest is lumbered have been marked on more than 6,000 acres, and rules which will control the lumbering have been prepared and have been approved by the Secretary of the Interior.

A working plan for the tract of the United States Military Academy at West Point was prepared at the request of the Secretary of War. The forest, which consists of hardwood sprouts, is in poor condition, the result of numerous fires and injudicious cutting. The plan is accompanied by forest maps, which show the location and area of the various types of forest, and provides for fire protection and for such improvement cuttings as will again put the forest in a sound and healthy condition. This plan is now being put into effect under the supervision of the Bureau of Forestry.

At the request of the Secretary of the Interior working plans were prepared for three Indian reservations in Wisconsin, which include recommendations for their protection from fire and rules under which they shall be lumbered without unnecessary damage to the forest.

ADVICE FOR PRIVATE OWNERS.

Ninety-four applications for assistance in managing forest lands were made by private owners. Of these applications, 37 were for timber tracts and 57 for wood lots. Since the Bureau put into effect its cooperative scheme of assisting private owners, applications have been received for advice in the management of 5,656,171 acres. Farmers and other private owners of small tracts of woodland throughout the Northeast, the Middle West, and the South Atlantic States have applied in increasing numbers for the assistance of the Bureau in the management of their tracts. Fifty-eight working plans for wood lots were prepared last year.

STUDIES AND WORKING PLANS.

Field studies of five large timber tracts were made as follows: On 39,000 acres in Berkeley County, S. C.; on 2,321 acres on the Susquehanna River above Harrisburg, Pa.; on 16,000 acres in Mitchell, Caldwell, and Watauga counties, N. C.; on a Longleaf Pine forest in southeastern Texas, involving field work on 300,000 acres, which occupied 35 men for four months; and on 125,000 acres in northwestern Maine, which occupied 32 men for three and a half months.

Working plans are in preparation for the following tracts: A forest of 25,000 acres in Sullivan County, N. H.; a forest of 50,000 acres in West Virginia; and a forest of 3,000 acres in Grafton County, N. H.

The forest of R. C. Neal, near Harrisburg, Pa., for which a working plan was prepared last year, is now under conservative forest management. Two field assistants of the Bureau are supervising the lumbering operations of a large company in Newton and Jasper counties, Tex. The working plan for the United States Military Academy at West Point is now in operation. Twenty-seven wood lots in the Northeast and South Atlantic States are being managed in accordance with the recommendations of the Bureau. The first selection of the Minnesota National Forest Reserve, consisting of 104,459 acres, is now under the Bureau's supervision. In addition to these lands, 679,194 acres of private lands and 106,759 acres of public lands not included in forest reserves are under forest management.

The interest which large railroad companies have recently exhibited in the practice of forestry is one of the most encouraging developments of the year. Many of them have made application to the Bureau for its cooperation in studies whose results would determine the advisability of the purchase and management of forest lands for the production of railroad ties and other timbers. Forest work for railroads offers very great opportunities for useful work.

Cooperative studies of State forest conditions, in which the States shared in the expense of the work, were made for Maine, New Hampshire, and California. In Maine the forests of Piscataquis County, south of Moosehead Lake, were studied. The results of the work were presented in the Fourth Report of the Forest Commissioner of that State. In New Hampshire a study of the forests of the entire State was begun, with the purpose of determining the methods by which they may best be preserved. In California the work was directed toward the making of a forest map of the State, the determination of practical modifications in lumbering methods, and of the effects of grazing and fire, and other matters entering into the determination of a State forest policy.

Studies were made of the Sugar Pine in California, the Lodgepole Pine in Montana, commercial hard woods in West Virginia, North Carolina, Tennessee, and Kentucky, the Balsam in the Adirondacks, the Chestnut in southern Maryland, and the Red Pine in northern Minnesota.

The section of Forest Measurements, without increase of force, accomplished nearly twice as much work as in the previous year.

WORK FOR THE COMING YEAR.

The work of the section of Forest Management for the ensuing year includes more important undertakings than ever before. Technical problems involved in the management of the National forest reserves must be solved; the field work in Texas, in South Carolina,

and in Alabama must be completed. Much work remains to be done on wood lots for private owners. On the lands to be included in the Minnesota National Forest Reserve those trees must be marked which are to be reserved in the lumbering, and supervision of the lumbering operations must be exercised by the Bureau. The study of the forests of California and of New Hampshire remains to be completed, and a study of Vermont forests will be undertaken. Commercial tree studies will be made in Maine, Minnesota, and the Southern States.

FOREST INVESTIGATION.

A notable accomplishment in the South during the year has been the extensive introduction of the cup and gutter system of extracting turpentine. This system, invented by Dr. Charles H. Herty, working under the Bureau's direction, although in operation only a year, is rapidly replacing the old, destructive system of boxing trees. Its great superiority is due to the fact that it is far less destructive than the box and that it yields at least 40 per cent more turpentine.

INVESTIGATIONS IN 1903.

Forest investigations were carried on in the following States:

In Maryland, a study of the distribution of the forests of St. Mary, Prince George, and Kent counties, in cooperation with the State Geological Survey.

In Texas, a study of the forest growth of the Edwards Plateau and its influence on stream flow.

In Missouri, a study of the swamp forests, including such timbers as Bald Cypress, and Red, Black, and Cotton gums.

In California, a study of the Tan-bark Oak in connection with the tan-bark industry.

In Ohio, Iowa, Michigan, and Montana, a study of forest distribution.

An investigation of the cedar-shingle industry was carried on in the Pacific Northwest, which included a study of the supplies of shingle cedar, the rate of consumption, etc.

The dendro-chemical laboratory, which was conducted in cooperation with the Bureau of Chemistry, obtained much valuable information in its study of gums and resins, the production of tannins, the use of different woods for pulp manufacture, the effects of poisonous chemicals on the life of trees, and the detection of adulterants in turpentine.

The life history of various insects harmful to trees in the East, South, and West was studied by the Division of Entomology in cooperation with the Bureau. It has been estimated that insects destroy every year $100,000,000 worth of timber. Experiments were carried on in methods of lessening this great damage.

Studies were made of the basket-willow industry and of the maple-sugar industry, and bulletins on both subjects are now in preparation.

WORK IN PROSPECT.

Work in forest investigations for the ensuing year will include—

Bulletins containing descriptions of the trees of the Northeastern, Southeastern, Rocky Mountain, Southwestern, and Pacific slope regions.

An attempt to clear up the confusion in the common names of trees.

A study of forest distribution in two counties of Maryland.

Special studies of forest distribution in Missouri and Arkansas.

A study of the Big Tree of California; of the acacias of the Southwest; and of the uses, structure, and characteristics of various American timbers.

Further experiments in turpentine orcharding under the cup and gutter system, to determine the minimum wound which it is necessary to inflict on the tree, the forest conditions which make for the highest productiveness, and the like.

A forest exhibit at the World's Fair, St. Louis.

FOREST EXTENSION.

Plans for tree planting were made for 68 applicants in 29 States. These plans, which involved the examination of 40,557 acres of land, were made in accordance with the cooperative plan inaugurated by the Bureau. Most of the plans were for farm wood lots of not more than 10 to 20 acres, but there were several notable exceptions. A plan was prepared for 108 acres on the Presidio Military Reservation of San Francisco. Planting plans were prepared for the grounds of the State institutions of North Dakota, at the request of Governor White. Other plans were prepared for farmers in the prairie regions along the Fort Worth and Denver City Railroad at the request of that company, and more than 600,000 trees were set out.

A planting plan was prepared for 640 acres in Cullman County, Ala., formerly covered by Longleaf and Shortleaf Pine. It was recommended that Loblolly Pine and White Oak, Post Oak, and Chestnut be planted on the land.

Men applying for planting plans show everywhere a disposition to follow the recommendations of the Bureau. Planting plans previously made are being carried out with encouraging prospects of success.

Tree planting continues on the Dismal River Forest Reserve of Nebraska and the San Gabriel Forest Reserve of California. The boundaries of the Dismal River Reserve have been surveyed and marked. Eighty acres of bottom land adjoining the reserve have been fenced, and part of the land converted into a tree nursery with space for the growing of 2,000,000 plants. Many thousands of Western

Yellow Pine and Jack Pine seedlings were collected in the Black Hills and in Minnesota for planting in the Dismal River Reserve. On the San Gabriel Reserve much experimental planting was done on widely scattered areas. The planting was done mostly with pine seeds in seed spots. The total cost averaged $7.41 per acre.

The natural reproduction of deficient forests has been studied among the hardwoods of Oklahoma, the Western Yellow Pine on the Prescott Reserve of Arizona, and the White Pine on the abandoned fields and pastures of New England.

A very important branch of the Bureau's work is the study of forest fires, with a view to discovering practicable means of reducing the immense losses due to this cause. The year covered by the present report was characterized by fires of extraordinary severity both in the East and in the West. The investigation of those which occurred in the East in the spring and early summer of 1903, however, was not begun in time to fall within the scope of the present report. The great forest fires of September, 1902, in Washington and Oregon were the subject of a special investigation by the Bureau, which discovered a total loss estimated at $12,767,100. The Bureau's investigation showed that most of the destruction was due to carelessness and might easily have been avoided. Forest fires were studied also in Georgia, Florida, and the Lake States, with a view to discovering their causes, methods of prevention, and the total amount of damage they do.

Examinations of the Atlantic Coast and Columbia River sand dunes were made in order that methods of tree planting might be discovered to restrain the encroachments of the shifting sands. Tree-planting plans for sand-dune regions on the Atlantic coast are in preparation, and a strip of sand-dune land in Oregon has been withdrawn for experiment.

Work for the ensuing year will include:

A continuation of cooperative work in tree planting among private owners.

Tree planting on Pikes Peak, Wichita, Prescott, and San Bernardino forest reserves.

Improvement of natural reproduction on Pikes Peak Reserve and on lands in northern New Mexico.

Extension of the timber belts of Kansas.

A study of the methods of restocking cut-over pine lands in southern Michigan.

A continuation of the study of second-growth White Pine in New England.

A cooperative study with the State of California in improving the stands of timber.

A study of the Eucalypts.

The suppression of forest fires and the reclamation of shifting sands will continue to receive the attention of the Bureau.

FOREST PRODUCTS.

A work of great scope and importance undertaken by the Bureau is the determination of the strength and durability of the merchantable timbers of the United States. The investigation consists of tests of timbers performed in cooperation with the Bureau of Chemistry. The work is directed toward the solution of practical problems of interest to engineers, and has been approved by many prominent engineers, manufacturers, and lumbermen. These tests are being conducted in laboratories at Washington, New Haven, Conn., and Berkeley, Cal., on Red Fir, Western Hemlock, and Longleaf and Loblolly Pine.

Wood preservation forms a most valuable feature of the work of the Bureau. Railroad companies have eagerly followed the results of this work, since it has so important a bearing on their interests. The work consists in experiments in methods of seasoning and preserving construction, railroad, and other timbers so as to increase their strength and their lasting powers. A special feature of the work which gives great promise of success is the experiments with cheap substitutes for valuable woods used for railroad ties. Such work has been done with the Lodgepole Pine in Montana, with gums, birches, and inferior oaks in Pennsylvania, Kentucky, Arkansas, and Mississippi, and with Loblolly and Shortleaf Pine in Texas. Methods of seasoning Chestnut poles were studies in cooperation with the American Telegraph and Telephone Company.

Examinations and reports dealing with technical problems in the management of forest reserves have been made for reserves in Utah, California, Oregon, and New Mexico. Twenty-nine agents of the Bureau this summer examined more than 20,000,000 acres proposed as forest reserves in the Rocky Mountain and Pacific coast States.

FORESTRY RECORDS.

Extensive improvements have been made in the equipment of the forest library. Many books, pamphlets, and clippings have been added, and the whole library has been completely classified and indexed. The collection of photographs has been increased by 3,417 views, taken in 41 States and Territories and in many foreign countries. The mailing list of the Bureau has increased by 75 per cent. Eighteen new publications were sent out, of which 237,000 copies were printed. Besides these, 23 press bulletins and reprints of 14 publications were issued.

BUREAU OF CHEMISTRY.

NEW INVESTIGATIONS.

EFFECT OF PRESERVATIVES AND COLORING MATTER UPON HEALTH.

As numerous experts of high character have declared both for and against the wholesomeness of many common food preservatives, and as the law authorizes the Secretary of the Treasury to exclude from the country food products to which any injurious substance has been added, the necessity for an investigation of these differences of opinion and the establishment of a wise and just conclusion in regard to them is apparent. To this end, as well as for the information of the public, an elaborate series of experiments has been inaugurated. It is evident, in view of the work previously done in this line, that neither mere theorizing on the chemical and physical properties of preservatives and coloring matter nor experiments upon other animals than man can lead to definite results. With this in mind an experiment was developed as follows:

Twelve young men, who responded to a request for volunteers, pledged themselves to use no other food or drink than that provided for them, with the exception of water, any water not used at the table to be measured and reported daily; to continue to be for at least six months members of the "hygienic table," and during this time to observe implicitly all rules as to diet, exercise, smoking, etc., laid down for them by the Chemist.

A period of rest was effected by placing six of the men at the observation table and the other six at the recreation table alternately throughout the period of seven months. Each experimental period varied from thirty to forty days, and was divided into a "fore period" of ten days, during which a standard ration for each man was determined; a "middle period" of from ten to fifteen days, during which time each member ate the ration previously determined, together with the added preservatives, which in this experiment were borax and boracic acid; and an "after period" in which the same ration was continued, but the preservative withdrawn, the object being to restore the body to its normal weight in case it had been disturbed by the preservative.

A daily record was made on blanks furnished each member of the table of the following data: Weight, pulse, temperature, all data connected with the income and outgo of the food, and an account of all the foods taken and the meals at which they were eaten.

By analysis it was possible to determine just what part of the food was consumed in the production of heat and energy within the system, provided the weight remained constant. Furthermore, any failure on the part of the individual to observe the pledge to partake of no food or drink except what was served at the hygienic table would have been at once disclosed by a disturbance of the balance sheet.

Such in brief was the nature of the experiment conducted. The mass of analytical data obtained is now in the hands of the calculators, and these data, together with such conclusions as an unprejudiced judgment would approve, will shortly be published. The recording of the facts as they occurred and the tabulation of the figures in the most scientific manner possible will present to experts a basis for conclusions. The experiment is to be continued, taking up the most important preservatives in turn, salicylic acid being the next to be considered.

INSPECTION OF IMPORTED FOODS.

Looking to the enforcement of the pure-food law, enacted March 3, 1903, and going into effect July 1 following, preliminary arrangements were made with the Secretary of the Treasury and the Secretary of State by which their active cooperation was secured. The Secretary of State issued directions to the United States consuls that special declarations concerning imported foods be made and forwarded to the Secretary of Agriculture, and through the Treasury Department the collectors of customs at the leading ports in the United States were instructed as to the steps necessary to be taken in sampling such cargoes as might be detained for examination and the reshipping or destruction of such shipments as might, upon analysis, be excluded from the country under the terms of the act.

TABLE SIRUP FROM ORDINARY SUGAR-PRODUCING PLANTS.

The investigations previously made in the Division of Chemistry, and the testimony submitted before the committees of the House and Senate charged with the investigation of the adulteration of food products, show that table sirups are generally adulterated in a degree corresponding to the price paid for them. Glucose is the material commonly used for the basis of this product. In this way the price of the genuine articles has been depressed to a point which renders their profitable production problematic. To combat this condition an investigation has been instituted to study the methods in vogue for the manufacture of table sirups, to ascertain how the product can be improved, and to conduct experimental work in the growing and fertilizing of sugar cane to determine methods for securing the highest financial returns. An elaborate fertilizer experiment was conducted on the farm of Mr. W. B. Roddenbery, at Cairo, Ga., from which practical results of a valuable nature were obtained and reported in Bulletin No. 75, Bureau of Chemistry.

The manufacturing data, obtained largely at the factory of J. T. Wells, Guyton, Ga., will be published in a separate bulletin when the additional experimental factory work now going on at Waycross, Ga., is completed.

COLLABORATIVE WORK WITH EXECUTIVE DEPARTMENTS.

The collaboration authorized by Congress between the Bureau of Chemistry and such Departments of the Government as may apply to the Secretary of Agriculture for chemical analyses has extended until it includes almost every branch of the service, the most extensive work having been conducted in connection with the Treasury Department. This collaboration included the sugar tests made on samples received daily from the appraisers' laboratories at New York, Boston, and Philadelphia, which comparative tests, extending as they have over a period of three years, have been productive of the most useful results in eliminating wide differences existing in the polarizations made at the ports named.

Other examinations made for the Treasury Department include an investigation of the percentage of ethyl alcohol in certain fusel oils imported into the country; an examination of the natural content of sugar in pineapples imported from different parts of the world; and the analysis of samples of ice and water intended for drinking purposes in the Bureau of Engraving and Printing.

Examples of cooperative work with other Departments are examinations of coal for the National Hospital for the Insane, at Washington, D. C., and paper for the Geological Survey, made at the request of the Secretary of the Interior; the examination of beverages offered for sale in Indian Territory, made on the request of the Attorney-General; samples of glue offered on competitive bids to the Government Printing Office; and a large amount of miscellaneous work for the Post-Office Department, including examinations of paper, ink, and stamps.

It is evident that work of this character, and especially such part of it as relates to the awarding of contracts, gains in uniformity and authority by emanating from one laboratory, and at the same time is more economically performed. The appreciation of this fact is seen in the constantly increasing number of requests received from other Departments for such work.

WORK OF THE LABORATORIES.

THE FOOD LABORATORY.

Upon this laboratory has devolved the greater part of the analytical work necessitated by the experiments with food preservatives, involving the examination of 5,500 samples, as well as all cooperative work on foods, such as pineapples, and the fermented beverage and fusel-oil investigations. In addition, an exhaustive study of olive oil and its adulterations has been completed; a study of the composition of apples with special reference to changes in composition during ripening under different methods of cold storage has been continued in collaboration

with the Pomologist of the Department; and 134 samples of fruit sirups and nonalcoholic beverages were secured in the open market and analyzed. The grape juices show a great improvement in the methods of preservation since the study made of them several years ago.

As heretofore, important work has been done in this laboratory in connection with the Association of Official Agricultural Chemists and the food chemists throughout the country in the investigation and comparison of methods for the analysis of foods. Two members of the staff have also done considerable work as associate referees on sugar for this association.

During the year a compilation of the pure-food laws of the various States was issued in five parts.

INSECTICIDE AND AGRICULTURAL WATER LABORATORY.

About 1,500 analyses were made in this laboratory, including the following lines of investigation: Mineral and irrigation waters; sanitary examinations of water; insecticides; the arsenic content of wall papers, furs, etc.; cattle foods; and toxicological examinations to determine whether bees are killed by poisons used in spraying. Most of these results, bearing directly as they do upon public health, either have been or will be reported in bulletin form. A portion of this work is performed in cooperation with the office of irrigation investigations and the Division of Entomology. Considerable work on methods of analysis for insecticides has been done by the chief of the laboratory as referee in the Association of Official Agricultural Chemists.

THE SUGAR LABORATORY.

In this laboratory the work on sugars for the Treasury Department was performed under the supervision of the Chief of Bureau. All analyses in connection with the cooperative experiments on sugar-producing plants (beets, sugar cane, and muskmelons) which have been conducted for several years in collaboration with various experiment stations are also made in the sugar laboratory. The total number of analyses reported was 1,744.

THE DAIRY LABORATORY.

Of the 1,056 analyses made in this laboratory, 807 were reported to the dairy division of the Bureau of Animal Industry, for which Bureau the chief of the laboratory served twice as a witness in a renovated butter case tried in New York State. The difficulty of distinguishing between butter produced by feeding cotton seed or cotton-seed meal and that to which foreign fats have been added, presented itself, and will receive special study during the coming year.

THE CONTRACTS LABORATORY.

The work performed in this laboratory included a large part of that referred to under collaborative work, and consisted mainly in the examination of samples submitted with bids for contracts to different branches of the Government, and in the development of qualitative and quantitative methods for the analysis of the same. Especially exhaustive examinations were made of khaki cloth for the Navy Department and 60 samples of ink for the Post-Office Department, a set of methods being determined in the progress of the latter work which were published as Circular 12, Bureau of Chemistry. Sample inks, prepared according to recipes developed in the laboratory, were sent to the Post-Office Department to be tested, and a set of standards established whereby to judge of an unknown ink.

THE ROAD-MATERIAL LABORATORY.

While the work of this laboratory has continued along the same general lines as in the past, its usefulness has been greatly extended, especially by the increase of its force.

The work of the chemist in charge included an investigation of the cause of the cementing power of rock dust, gravels, and clays, which involved many complete analyses and resulted satisfactorily. Other researches of immediate practical value have included a series of experiments on the burning and clinkering of clays, with a view to their use as road materials, and a study of the possibilities of increasing the binding power of materials by artificial means. During the coming year it is hoped that a thorough, practical test of burnt clays for country highways may be completed, as there are vast areas throughout our country where this is the only road material available, and the determination of the quality of clay adapted to this purpose would solve a great problem in road building.

Another important problem being studied in connection with such localities involves an elaborate series of experiments with mixtures of crude petroleum and asphaltum. The object of these experiments is to provide a binder surface for country roads which will place what would be practically an asphalt road within the reach of all rural districts, the cost of this mixture and its application being less than that of watering a macadam road.

Two new tests for determining the hardness and toughness of rock are to be adopted and reported on all routine samples, which it is believed will be of great assistance to road builders. These tests represent a new field of investigation and the machines for making them have been designed and are now in operation.

Other questions to receive special consideration are the testing of cement and concrete for road foundations, drains, and highway bridges,

and tests on paving brick. The general testing of rock for macadam roads will be continued.

A bulletin on the testing of road materials, giving a detailed account of the methods employed and the results obtained in this laboratory, is now in press.

THE DRUG LABORATORY.

This laboratory went into operation on March 1, 1903, and has already reported on 120 samples of drugs and chemicals. The work so far done on representative samples of drugs shows that some of these articles are of a very unsatisfactory character. A bulletin entitled Adulterated Drugs and Chemicals is about to be issued.

BUREAU OF SOILS.

PROGRESS AND COST OF THE SOIL SURVEY.

The work in which the Bureau of Soils is engaged forms an important link in the chain of duties devolving on the Department. It is fundamental in character, and as the survey and classification of the soil progresses the results are being more and more made use of by other offices of the Department, as well as by outside investigators and by our citizens.

Up to this time the distribution of the surveys has been influenced by the desire to gain as wide a knowledge as possible of the soils used in the most important agricultural industries of the country, and in this way the work has been scattered through all parts of the country. Thus studies have been made of Eastern and Western fruit districts, of sugar beet lands, of the cotton and rice lands of the South, of the corn lands of the Central West, and the wheat lands of the Northwest and the Pacific coast, and of the soils of all the important tobacco districts.

One important purpose of the work is to provide data for the comparative study of more or less widely separated areas devoted to the cultivation of similar products, with a view to carrying the better practices of one area to the other, and of suggesting improvements in the methods used and changes in the kind of crops grown. It is one purpose of the work to show where old industries can be extended or new ones established, while the value of the reports and maps to those wishing to purchase lands for any specific purpose is too evident to need emphasis.

The statistics collected by the Bureau will be particularly important in the carrying on of immigration and colonization enterprises.

The area surveyed and mapped during the fiscal year was 23,293 square miles, or 14,907,520 acres, an area just about equal to the total area previously surveyed since the beginning of the work, four years ago.

This enlarged work has been accomplished in part by the organization of five new field parties on the 1st of March, made possible by increased appropriations by Congress, and partly by keeping the parties continuously in the field, moving to Southern areas in the winter. While considerable time was lost in some of the areas by reason of excessive rains, upon the whole this plan has worked well and has materially reduced the cost per square mile. The work has been carried on during the year in 63 areas in 34 States and Territories, as shown in the following tables:

Areas surveyed and mapped during fiscal year ended June 30, 1903, and the areas previously reported.

State or Territory.	Work during 1903.	Work previously reported.	Total.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
Alabama	1,223		1,223	782,720
Arizona	108	503	611	391,040
Arkansas	251		251	160,640
California	1,959	1,962	3,921	2,509,440
Colorado	1,195	150	1,345	860,800
Connecticut	273	245	518	331,520
Florida	548		548	350,720
Georgia	186	571	757	484,480
Idaho	678	399	1,077	689,280
Illinois	2,241	1,356	3,592	2,298,880
Indiana	387		387	247,680
Iowa	576	440	1,016	650,240
Kansas		464	464	297,600
Kentucky	536	330	866	254,240
Louisiana	705	202	907	580,480
Maryland	463	2,147	2,610	1,670,400
Massachusetts	267	143	410	262,400
Michigan	30	828	858	549,120
Minnesota	233		233	149,120
Mississippi	661	656	1,317	842,880
Missouri	751	168	919	588,160
Montana		107	107	68,480
New Jersey	395	908	1,303	833,920
New Mexico		129	129	82,560
New York	1,075	483	1,558	997,120
North Carolina	1,221	3,425	4,646	2,973,440
North Dakota	856		856	547,840
Ohio	375	980	1,355	867,200
Oregon	382		382	244,480
Pennsylvania	278	938	1,216	778,240
Porto Rico		330	330	211,200
South Carolina	1,346	686	2,032	1,300,480
South Dakota	485		485	310,400
Tennessee		547	547	350,080
Texas	1,238	495	1,733	1,109,120
Utah	200	794	994	636,160
Virginia	1,171	1,604	2,775	1,776,000
Washington	51	459	510	326,400
Wisconsin	955		955	611,200
Total	23,299	22,445	45,744	29,276,160

Cost of survey.

Cost of field work	$51,136.60
Supplies	1,901.59
Traveling expenses between areas	5,215.76
Other expenses	5,059.56
Total cost of soil survey	63,313.51
Paid by State organizations	1,748.35
Paid by Department of Agriculture	61,565.16
Area surveyed ... square miles	23,299
Cost of work in field per square mile	$2.19
Transportation, supplies, and other expenses per square mile	$0.52
Total cost per square mile	$2.71
Cost to Department of Agriculture per square mile	$2.63

The cost of work in the field has increased from $1.83 per square mile, as reported last year, to $2.19 per square mile. This is due in part to increased salaries, necessitated by the fuller experience of the principal assistants, and in part to a large amount of rainy weather in the winter, which raised the cost in some of the Southern areas very considerably above the average.

On the other hand, the advantage of keeping the men out, in spite of the delays from the winter rains, is seen in the reduced cost per square mile where all expenses chargeable to the soil-survey work are included. Last year the average cost to the Department of Agriculture was $2.81 per square mile, and this year the total cost is $2.63 per square mile. It is probable that this is the lowest cost that can be reached, and from now on the cost may gradually increase somewhat, owing to the increased salaries which it may be necessary to pay to hold experienced men in the service.

There has been a great demand for our men from colleges and experiment stations and in private enterprises, but it has been the desire of the Department to keep the men at least five years in the soil survey, after which it is believed they will have had as much experience as they can get from such service, and they should then be prepared to take up special lines of investigation, or be ready to enter into positions of responsibility in educational institutions where soil investigations are being built up.

Although a total of $61,565.16 was spent by the Department for the soil-survey work and $1,748.35 by State organizations cooperating, and 63 areas were surveyed and mapped, with an average of 369 square miles each, we were unable to reach more than half of the areas in which surveys have been requested, and we have on file requests for nearly two years' work with the number of parties available with our present appropriations.

PUBLICATION OF THE REPORT ON FIELD OPERATIONS.

In my last report I called attention to the urgent need—if the full benefit of the soil-survey work is to be secured—of a change in the manner of publishing and distributing the reports on the soil surveys. As the law now stands, in the joint resolution approved February 23, 1901, the manuscript of these reports has to be submitted to the Public Printer all at one time, and the reports must be issued as one volume, with the maps in an accompanying portfolio. The Senate and House of Representatives together have 9,000 copies and the Department has 8,000 copies for distribution. This gives each Representative about 16 and each Senator about 32 copies—about enough for the public libraries and institutions in their respective States. In addition, the Department has usually ordered from 500 to 1,000 reprints of the report on each separate area, and has distributed these as far as they would go in the districts to which the work pertains. Besides being entirely inadequate to fill Congressional needs, this manner of publication has the disadvantage of not enabling the Department to meet the local demands.

One of the chief values of this work lies in the suggestions it affords to the owners of land in the area in directing their attention to new crops and to better methods of agriculture. The bound copies that go to libraries, public institutions, and prominent citizens are very good as works of reference; but for the utmost good to come of the soil survey, copies of the separate reports and soil maps should be placed in the hands of a considerable number of people within the area surveyed, and our experience in the past has shown that there are from 500 to several thousand requests of this kind that the Department has not been able to meet. I would therefore recommend to Congress that, in addition to the bound volumes already authorized, there be printed in the form of advance sheets, as soon as the manuscript, maps, and illustrations can be prepared, a separate report on each area surveyed as completed, of which 500 copies shall be for the use of each Senator from the State, 2,000 copies for the use of the Representative for the Congressional district in which the survey lies, and 1,000 copies for the use of the Department of Agriculture. The reports could in this way be sent out from six to twelve months earlier than is now possible, and could be distributed while the matter is still fresh in the minds of the people who have watched the progress of the field work. It would also be practicable in this way to supply the local demand, a thing quite impossible under the present plan.

ALKALI RECLAMATION.

During the past year the Bureau of Soils has been engaged in making alkali reclamation demonstrations in several parts of the arid

West. One such experiment is located near Salt Lake City, Utah, where there is an area of about 120 square miles (75,000 acres) of land unproductive because of excess of alkali. A tract of 40 acres, typical of this waste land, was secured in the summer of 1902 for the purpose of experiment, and the work of reclamation, which is being done in cooperation with the Utah experiment station and the owner of the land, has progressed rapidly and satisfactorily.

At the time of beginning the work on this tract it contained a little more than 2½ per cent of salt, or a total of 6,650 tons of salt in the soil to a depth of 4 feet. At the present time there has been removed from this tract, by the simple method of underdrainage and flooding, two-thirds of this quantity.

The following table gives the quantity of water added to the 40-acre tract and the amount of salt added in the irrigation water. The period covered extends from September 1, 1902, to September 1, 1903.

Total quantity of water used in flooding and amount of salt added from this source in the experiment at Salt Lake.

Date.	Water added.	Source of water.	Salt added.
1902.	*Cubic feet.*		*Pounds.*
September	284,400	Canal	24,000
October	940,000	....do	83,900
November	171,300	Rain	
December	166,500	....do	
1903.			
January	291,800	Rain	
February	136,400	....do	
March	132,000	....do	
April	112,000	....do	
May	576,900	....do	79,000
Do	760,900	Canal	70,700
June	106,000	Rain	
Do	676,500	Canal	169,190
July	36,588	Rain	
Do	1,691,966	Canal	
August	2,122,157	....do	212,000
Total	8,305,411		638,790

The following table shows the drainage from the tract from September 1, 1902, to September 1, 1903, and the quantity of salt removed in the drainage water during that period:

Total quantity of water carried off through the drains and the quantity of salt removed in this way in the experiment at Salt Lake.

Date.	Drainage.	Salt removed.
1902.	*Cubic feet.*	*Pounds.*
September	158,700	152,200
October	265,000	195,100
November	251,000	353,800
December	139,700	187,600
1903.		
January	257,300	391,200
February	174,400	214,800
March	428,000	590,700
April	26,900	26,500
May	521,500	567,100
June	274,500	345,200
July	480,490	556,459
August	814,890	1,221,742
Total	3,792,380	4,802,601

From the foregoing tables it will be seen that there has been added to the Swan tract 8,305,411 cubic feet of water, equivalent to 57 inches in depth over the entire tract, and of this quantity 3,792,380 cubic feet, or 45 per cent, was recovered in the drainage. This drainage water, equivalent to 26.2 inches in depth over the entire tract, carried 2,401 tons of salt. Should we consider the seepage water which has drained into the subsoil and not out through the drainage tile, it is likely that at least 4,000 tons of salt have been eliminated from the land.

Seventy-five per cent of the area of the tract at Salt Lake contained less than 0.40 per cent of alkali in the first foot of soil as against 2½ per cent one year ago, and the entire area, it is believed, will be sufficiently sweetened by the end of the present season to permit the growing of a shallow-rooted crop. It will be seen from this that the ultimate complete reclamation of the land seems assured, and the Department believes that the object lesson thus afforded the farmers of this and other arid regions will stimulate them to take up the work of reclaiming these waste but fertile lands.

The value of the alkali lands at Salt Lake City is only $8 an acre, while lands not affected by alkali bring from $100 to $350 an acre. The cost of installing the drainage system was about $16 an acre, so that even with the additional cost of the irrigation water the margin of profit in the reclamation of these lands is wide enough to interest capital.

Besides the work at Salt Lake City, a tract of 20 acres near Fresno,

Cal.—where lands have depreciated not less than $1,000,000 in value in the last few years on account of the rise of alkali—was taken under lease for reclamation. This land was at one time sold for $350 an acre, but had become badly alkaline, and was abandoned and of merely nominal value at the time of undertaking its reclamation. The work at Fresno has been quite as successful as at Salt Lake City, and at the end of four and a half months the greater part of the 20 acres was in condition to permit the planting of alfalfa, which crop will be seeded as soon as the proper season arrives.

The cost of installing the drains at Fresno was $15 an acre, but at Yakima, Wash., where a third experiment is under way, the cost was $21 an acre, a difference due mainly to the higher price for drain tile. The system at Yakima has also been successfully installed, and land, worthless for agricultural purposes at the inception of the experiment, will, it is believed, be in as productive a condition at the end of two years as contiguous lands now valued at $150 an acre.

It is the purpose of the Department to establish six of these demonstration experiments in parts of the West where there has been great loss from the rise of alkali. The need for such object lessons has been forcibly impressed upon the Department by the apathy of the communities where the alkali evil exists and increases. The people seem to stand in awe of alkali and to doubt that they can cope with it, notwithstanding the insistent teachings of experts to the contrary. This is not the case in Egypt, where vast areas of land more salty than any but the very worst soils in the Colorado Desert have been reclaimed by practically the same methods as those recommended by the Department and now successfully in use in these experiments. And these demonstrations have been undertaken in the belief that when the people see that the rise of alkali can be prevented, or that where alkali has accumulated it can be economically removed, they will take the matter into their own hands and either privately or cooperatively set about the systematic protection and reclamation of these very valuable western lands.

TOBACCO INVESTIGATIONS.

Some supervisory work was done in Connecticut during the past fiscal year, but the large purpose of the Department, which was to show the Connecticut tobacco growers that a wrapper leaf of superior quality could be produced on a specific soil type established in the soil survey of the Connecticut Valley, has been successfully brought to a close. It remains now for the growers to put the shade-grown Sumatra industry on a substantial basis, toward which condition great progress has already been made.

The investigation of the fermentation of Ohio tobacco has also been continued, and the interest in bulk fermentation, which is far better

than the case method up to this time largely employed by the packers, is gaining ground.

The quantity of tobacco handled according to the method prescribed by the Bureau of Soils has increased from 655,200 pounds of the 1901 crop to 4,204,800 pounds of the crop of 1902. This tobacco is Zimmer Spanish and Little Dutch, varieties used in the manufacture of cigars, and the substitution of the bulk method of fermentation for the present practice of case fermentation will not only prevent great loss from rot and imperfect curing, but will also result in a general improvement in the several grades of this tobacco, and thus greatly increase the profits of the grower and packer.

By far the most important work of the Bureau of Soils during the past year, under the authorization for tobacco investigations, has been the experimental growing of Cuban cigar-leaf tobacco on certain soils in South Carolina, Alabama, and Texas. These soils, the Orangeburg sandy loam and the Orangeburg loam, are apparently very similar to the tobacco soils of Cuba, and the aroma of the leaf grown on one of these soils in Texas has been pronounced by the trade to be very fine. The crops grown on the experimental plots are now in course of fermentation, and it is too early to state definitely what the outcome will be, but so far as is now known the quality of the leaf will be excellent.

As these experiments in the South look toward the establishment of a new tobacco industry in that part of the country and to the production of a leaf to compete with the Cuban grown tobacco, a comparative statement of the production and value of the domestic leaf and the imports and value of the Cuban tobacco is appended.

Production and value of filler tobacco in 1901.

Type.	Production.	Value.
	Pounds.	
Ohio	35,654,314	$3,832,839
Pennsylvania	17,614,380	2,113,725
Other domestic filler	17,666,531	1,971,584
Total domestic filler	70,935,225	7,918,148
Imported Cuban, 1901	18,554,775	16,212,773

In the above table the production of the domestic tobacco is on the basis of the fermented leaf, 20 per cent having been deducted from the total production for shrinkage in fermentation and loss in handling. In the case of Ohio the necessary allowance for other types than the filler types grown in the State has been made. Two cents per pound has been added to the value of the domestic tobacco to provide for the expense of fermentation, etc., thus putting the Cuban imports and domestic filler on the same basis. It will be seen from these figures

that the Cuban imports, while only one-fourth as great in quantity, represent two and one-third times the value of the domestic product.

It is the purpose of the Department, if the results of this year's work warrant, to carry on the filler experiments in the South on broader lines, similar to those of the Sumatra experiments in Connecticut, and then to extend its operations into other States where the results of the soil survey show that tobacco can be raised or where improvements can be made.

WORK OF THE SOIL LABORATORIES.

Besides routine work the laboratories of the Bureau of Soils have been developing several special investigations in the physics and chemistry of soils. Much of their work is of a purely technical character, necessary to a proper understanding and handling of the large soil problems which the Bureau is investigating, but not in itself of immediate interest or value to the practical agriculturist. Some of the work, however, has an immediate interest and is of a far-reaching and fundamental character.

The subject of most practical importance to the farmers of the country is the yield of crops, which has been popularly believed to be more or less directly influenced and controlled by the chemical characteristics of the soil. The Bureau has therefore made an exhaustive research, the results of which modify very materially the current conceptions of this matter. In considering the question the aim was to determine what amount and proportion of the several mineral plant foods were actually in solution in the soil at any one time, or from time to time; since it has been admitted by practically all authorities that it is the solution naturally existing in soils which is the immediate source of the mineral foods obtained by the crops growing upon them. Birner and Lucanus, as long ago as 1866, pointed out that plants can be grown to perfection in well water if suitable physical conditions are preserved, and, as a matter of fact, they grew oat plants in such water, renewed weekly, the yield of grain being double that from a rich garden soil.

Until the work was undertaken in this Department it had never been possible to make a satisfactory study of this subject, owing to the difficulties encountered in isolating the natural nutrient solution from the solid soil and in analyzing this solution for the extremely small amounts of dissolved material maintained in it.

By careful work and unusual ingenuity these analytical difficulties have been surmounted by the Bureau and methods devised that enable us to obtain the soil solution and to estimate, with a degree of accuracy little short of marvelous, the amounts of the constituents contained which are of significance for plant growth. Moreover, by means of portable outfits it has been possible to make these determinations in

the field, where local conditions can be studied in conjunction with the analysis of fresh soil samples.

The chief of the Bureau, Professor Whitney, concludes, from the consideration of some hundreds of examinations with these new and exceedingly delicate methods, that there is no apparent relation between the dissolved salts of the soils, as determined by the methods, and the yield of crops, and that there are no constant differences between the different types of soil, although these types differ widely in their agricultural values. With such small differences as were actually found, quite as often the larger amount of plant food was found associated with a poorer crop, and vice versa; and, furthermore, the chemical differences between soils of various types with known wide variations in agricultural value, or between soils of the same type supporting on the one hand good, on the other poor crops, were no larger than those found between soils yielding approximately equal crops.

He argues, therefore, that nearly all soils are amply supplied with the necessary mineral plant food, and that these plant foods are not in themselves a matter of paramount importance to the agriculturist, for their supply as regards the plant is determined by the supply of soil moisture which the crop can obtain from the soil; that the chemical analysis of a soil can not in itself, therefore, throw much light upon the problem of fertility, but when the farmer attempts to control the factors governing crop yield his attention must be directed to the mechanical condition of the soil as affecting the supply of soil moisture with its dissolved mineral nutrient, to the effects of climate, to rotation, and to general soil management. These matters have all been fully treated in a recent publication (Bulletin No. 22) of the Bureau of Soils.

BUREAU OF STATISTICS.

WORK OF THE YEAR.

The work of the Bureau of Statistics has been continued on the usual lines. In addition to the regular work in estimating crop conditions, etc., statistical matter relating to the principal crops and farm animals, freight rates, exports, etc., in the United States and foreign countries has been prepared for publication, and numerous inquiries from various interested parties as well as Bureaus and Divisions of this Department have been answered, all of which has necessitated a vast amount of research and compilation.

Several special reports have been published during the year. These reports include a statistical description of the "Wheat Ports of the Pacific Coast," "Practices in Crop Rotation," "Flaxseed Production," "Commerce and Manufacture in the United States," "Milk Transportation: Freight Rates to the Largest Fifteen Cities in the United

States," and "Relations of Population and Food Products in the United States."

FOREIGN AGRICULTURAL STATISTICS.

The statistical expert who has for some years had charge of the crop statistics of foreign countries competing with the United States has been stationed during the year in London, England, where he has been in closer touch with the statistical offices of the different European governments, whose reports, along with the most authoritative commercial intelligence of interest to American agriculturists, he transmits to Washington by mail or cable from time to time. Negotiations with the governments of various important grain-producing countries of Europe, and also with that of the Dominion of Canada, looking to a telegraphic interchange of crop reports similar to that already in operation between the United States and Hungary have been continued, and it is not improper to state that these negotiations have now reached such a stage that there are good grounds for believing that the growing season of another year will see the American farmer placed in as prompt possession of trustworthy statistics concerning the principal grain crops of foreign countries as he is of those of the United States.

COOPERATION WITH OTHER BUREAUS AND DIVISIONS.

During the year there has been cordial cooperation between the Bureau of Statistics and the Bureau of Plant Industry, the Bureau of Animal Industry, the Bureau of Forestry, and the Bureau of Soils, with such satisfactory results as to assure even greater cooperation and mutual dependence in the future than in the past. Throughout the whole of the research work of the Department the best results have been obtained by the cooperation of one set of specialists with another. The statistical work contained in the various publications of the different branches of the Department of Agriculture is largely done by employees of the Bureau of Statistics, and such statistical work as is not done in that Bureau is carefully revised by the Statistician and receives his approval before being published as the work of any other Division or Bureau of the Department.

COST OF CROP PRODUCTION.

In cooperation with the State Agricultural College of Minnesota, an investigation is being conducted by the Division of Statistics to determine the cost of production per acre of the principal crops. Although this work is not sufficiently complete to permit of publication of results at the present time, these data, when properly tabulated and analyzed, will undoubtedly be of great value in solving questions of farm management, and various other problems that confront the modern farmer.

THE STATISTICAL LIBRARY.

While there is no branch of statistics having a close relation to the agricultural industry that is not more or less adequately represented in the Department's statistical library, as regards the literature of prices, it is believed to be the best equipped library in the country, and no reasonable expenditure that may be necessary to maintain its present high standing should be withheld. Its card index to agricultural statistics is exceptionally complete and well arranged and has proved of great value to visitors who have had occasion to consult it.

BUREAU ORGANIZATION.

On July 1, 1903, the Division of Statistics became a bureau, and the Division of Foreign Markets was placed under the direction of the Statistician. Both the clerical and field forces will now be materially strengthened, and, while the work must necessarily be continued along practically the same lines as heretofore, no effort will be spared to strengthen and improve the reports on the staple crops and give more detailed information with regard to fruits and various minor crops. Until the present year it was found impossible to make quantitative estimates of any but the principal crops, but flax was added during the year, and the necessity for extending this work to embrace other products—such as rice, sugar, fruits, etc.—is every day being more forcibly brought to the attention of the Department. With a moderate addition to the field force the organization for collecting data will be sufficiently well organized to enable the Statistician to include details of all minor crops and of fruits in his monthly reports. But to successfully extend the work to embrace these crops it will be necessary to strengthen the office force by the appointment of a sufficient number of computers to collate and analyze the reports sent in by correspondents and field agents.

The organization of the field force has already been carried to a very high state of efficiency, and it is proposed materially to increase this efficiency by the appointment of additional field agents so soon as the bureau organization becomes effective.

It is my desire to so strengthen this Bureau as to enable it to become, as I conceive it should be, the principal source of reliable information on the agricultural resources of the country.

FOREIGN MARKETS.

COMPREHENSIVE INVESTIGATIONS.

Special comprehensive investigations involving much labor in the collection of statistics and in table building have engaged the efforts of the Division of Foreign Markets during the fiscal year. These investigations bring together vast amounts of information concerning

the trade of this and other countries in exporting and importing farm and forest products which has not hitherto been in form readily available to the general public.

TARIFFS OF FOREIGN COUNTRIES.

On account of the numerous changes in the tariff laws of many important countries, frequent inquiries are referred to this Division for information regarding tariff rates and customs regulations of certain agricultural products in foreign countries.

In order to supply this information in condensed form, the Bureau has been charged with the publication of a series of bulletins giving, in English, the import duties on certain important groups of agricultural products that are levied in foreign countries.

The greatest care has been exercised to make this information accurate, and no efforts have been spared to get the most recent information from each country.

The countries, including their colonies and dependencies, for which these tariff schedules have been compiled, number 162, which includes, for the sake of completeness, the tariff of the United States and that of the Philippine Islands.

FIFTY YEARS OF EXPORTS.

The numerous demands for information as to export statistics of farm products from the United States, covering a period of years longer than the ten-year statements customarily made by this Division, have suggested the compilation of tables showing these exports for a long period of years, beginning with 1851. From these tables are derived the figures on our exports of farm products given in the earlier portion of the present report.

These figures exhibit a steady and regular increase in the volume of our agricultural export trade, in which cotton, grain and grain products, and meat and meat products were the principal factors. Other important items were live animals and tobacco. The five items mentioned have formed the bulk of our agricultural export shipments throughout the period 1851–1902, with the exception of the years 1861–1865 when, on account of the civil war, our exports of cotton were almost entirely suspended.

GERMAN IMPORTS OF FARM PRODUCTS.

The imports of farm products into the German Empire were made a special subject of inquiry by the Division of Foreign Markets, and resulted in a full analysis of products by kind and by country of origin.

Farm products constitute a much larger percentage of the imports of the German Empire than they do in this country, the percentage

for Germany being 59.2 for the five years 1897-1901. The average annual value of the farm products imported from 1897 to 1901 was $745,198,480; the amount for 1901 was $790,564,700, of which amount the United States supplied 21.9 per cent. Of the imports of agricultural raw materials, the United States supplied 20.5 per cent; food products, 21.7 per cent; feed stuffs, 37.3 per cent; miscellaneous farm products, 3 per cent.

As contributors to the imports of farm products into Germany the various countries rank in order as follows, with the percentage of imports derived from each: United States, 21.9 per cent; Russia, excluding Finland, 16.3 per cent; Austria-Hungary, 10.6 per cent; British East Indies, 5.6 per cent; Argentina, 5.4 per cent; Italy, 4.4 per cent; France, 4.4 per cent; the Netherlands, 4 per cent; Brazil, 3.2 per cent; Belgium, 2.8 per cent; United Kingdom, 2.7 per cent; Dutch East Indies, 2.4 per cent; British Australasia, 2.4 per cent; Denmark, 1.6 per cent; Switzerland, 1.6 per cent; Roumania, 1.3 per cent. No other foreign country has a percentage as high as 1.

TRADE IN FOREST PRODUCTS.

This subject, which had hitherto received scant attention, has been made a prominent subject of investigation during the year just closed, and will hereafter receive the attention of this Division in conjunction with the subject of trade in farm products.

While it is true that in the immense aggregate of our foreign trade forest products occupy a small place relatively, yet, expressed in value, this trade has grown to large proportions, the growth being more especially manifest in exports than in imports. The domestic exports of forest products in 1893 amounted to $28,127,281, and during the five years 1893-1897 the annual average was $31,782,928. During the following five years, 1898-1902, the annual average grew to $47,648,530, the highest amount for one year being $55,369,161 for 1901. This average was considerably exceeded in 1903, when the amount was $58,281,124. During the eleven years the value of the domestic exports of forest products was about 3 to 4 per cent of the total domestic exports.

During the five years 1893-1897 the annual average value of the imports of forest products was $44,638,795, an amount from which the imports for each year did not vary much. In the following five years the annual average increased about $10,000,000, making the average for 1898-1902 $55,205,996; the highest amount for one year was $60,633,078, in 1900. In 1903 the value of the imports of forest products rose to the highest figure yet attained, $71,478,022. The relation between the value of the imports of forest products and the total imports is expressed by 5.9 per cent for the five years 1893-97,

being 7.1 per cent for the five years 1898–1902 and 7 per cent for the year 1903.

The imports of forest products are constituted chiefly of various gums, india rubber, cork, dyewoods and their extracts, and cabinet woods; also timber, lumber, and wood pulp, principally from Canada. It appears, then, that the principal portion of these imports is of materials that do not grow in this country or, if growing here, are not produced in sufficient quantities for the demands of consumption, as in the case of timber, lumber, and wood pulp.

The imports of agricultural products for 1903 amounted to $456,199,325, a higher amount than for any preceding year and $36,060,037 greater than for 1900. Of the total imports, 44.5 per cent are classified as belonging to farm products. This percentage shows a decline; for the five years 1893–1897 it was 51.5 per cent and for the five years 1898–1902 it was 48.7 per cent.

Farm products have declined as an element of domestic exports also during the last eleven years, although no decline is perceptible during the last five years. In 1903, 63.1 per cent of the total domestic exports was composed of farm products.

Upon combining the domestic exports of forest products with those of farm products, the total constitutes 67.3 per cent of all domestic exports for 1903. The percentage for the preceding five years was 68.8. The value of the farm and forest products exported for 1903 was $936,760,575, compared with which is the annual average of the preceding five years, $908,686,344, and the average of the five years 1893–1897, $647,857,875.

These two classes of products constituted 51.4 per cent of the imports of 1903, the percentage for the preceding five years being 55.8 and for the five years 1893–1897, 57.1. In value the imports of these two classes of products in 1903 amounted to $527,677,347, in comparison with which are the annual average of the five preceding years, $434,331,088 and the annual average of the five years 1893–1897, $33,805,721.

DIVISION OF ENTOMOLOGY.

WORK ON INSECTS FROM ABROAD.

THE ASIATIC LADYBIRD ENEMY OF THE SAN JOSE SCALE.

In the report of last year a rather full statement was made concerning the importation of a ladybird enemy of the San Jose scale, found in China and Japan by the first assistant entomologist. During the late summer of 1902 eight colonies of this beetle were distributed in six States. In the experimental orchard of the Division of Entomology the insect wintered well out of doors, and started breeding early the present season. The colonies distributed

during that summer were mainly put in charge of entomologists of State experiment stations. During the early summer of 1903 some 26 colonies were distributed in Maryland, North Carolina, Georgia, Alabama, Delaware, New Jersey, New York, Ohio, Oregon, Tennessee, Virginia, and West Virginia.

Of last year's distributions, those sent to Georgia have given the best promise. One of these established in a large orchard of 17,000 peach trees, with a contiguous orchard containing 250,000 trees, both orchards infested with scale, shows the most satisfactory results. By the 1st of July, 1903, the ladybird had spread through the original orchard of 17,000 trees and then occurred to the number of thirty or forty thousand. Three additional broods are expected during the season, and these numbers should be vastly augmented. Colonies have been distributed from this orchard to various parts of Georgia.

The experiences of the year have, therefore, been very encouraging. Every effort will be made to distribute this beetle throughout the regions where the San Jose scale occurs. The work, however, is still in the experimental stage, and too great hopes should not be aroused. Recommendations for the prompt application of sprays and other remedial treatment should not be neglected.

OTHER BENEFICIAL INSECTS.

The fig fertilizing insect continues to be a great success in California. Large crops of figs were raised at Fresno, and the quality seems to have been even better than during the previous year. A number of new orchards of Smyrna figs and caprifigs have been started, and there is no doubt that the insect has been thoroughly acclimatized at Fresno and at Niles.

One of the most striking of the recent beneficial results of these introductions has been the good work done by the parasitic enemy of the black scale (*Scutellista cyanea*) which was originally imported by the Division of Entomology from Italy and later from South Africa, and established in the orange and olive groves of California. The best work has been done in the southern part of the State, where the insect has been established in every county south of Point Conception. It is very plentiful in Los Angeles, Orange, and San Diego counties, and is still being sent out from the office of the First Deputy Commissioner of Horticulture at San Francisco. The Los Angeles commissioners distributed over 400 strong colonies at Escondido. At Pasadena the insects have spread naturally, and in the colonization districts over 90 per cent of the black scale has been destroyed by the parasite, which is still breeding.

WORK ON THE COTTON BOLL-WEEVIL.

The continued spread of the cotton boll-weevil, and the danger threatening the most important industry of the South by the direct prospect that it will soon reach all portions of the cotton belt, resulted in the appropriation by Congress of $20,000 for a continuation and enlargement of the work of the Division with that pest. This work was under the direct charge in Texas of Mr. W. D. Hunter, who was aided by a number of assistants.

The funds at the disposal of the Division enabled it for the first time to conduct experiments with the cultural methods of controlling the pest on a large scale. This was accomplished by entering into contract with two representative large planters in typical situations in Texas. By the terms of these contracts the planters agreed to plant, cultivate, care for, and in every way manage the crop exactly in accordance with the directions of the agent in charge. In this manner the Division was given practically complete charge of 325 acres, but without the trouble and expense of renting the land and working the crop. These experiments were located at Calvert, in the Brazos Valley, the most seriously infested portion of the territory at present, and at Victoria, in the extreme southern portion of the State, where the existence of volunteer cotton furnishes the weevils with food very early in the season, thus adding an important feature to the problem that does not occur elsewhere.

At Victoria a field laboratory was fitted up, where a thorough study was made of every feature of the life history of the weevil. The matter of parasites and the possibility of controlling the pest by their artificial propagation, which has always appealed strongly to many planters, received especial attention. In pursuance of this feature of the investigation the agent in charge made a trip to Mexico, where the governmental commission that had been created for the study of the weevil problem has especially concerned itself with the propagation of a mite (*Pediculoides ventricosus*), which, at least under certain conditions, has been found to destroy the larvæ of the pest. The agent made a study of the methods pursued in the laboratory of the commission at Cuernavaca, and through the courtesy of Prof. A. L. Herrera, the head of the commission, he was enabled to bring back to Texas a large number of cultures. These parasites were distributed from the laboratory at Victoria. The work is being continued this season, but the indications are that climatic conditions will always render unobtainable in Texas whatever useful results may have been obtained in Mexico.

WORK ON INSECTS DAMAGING FORESTS.

With the beginning of the fiscal year a section of the Division of Entomology was organized for the investigation of insects injurious

to forests. Dr. A. D. Hopkins was put in charge of this work, and during the year three assistants were assigned to him. The work was carried on in cooperation with the Bureau of Forestry, and investigations have been made in nearly all of the States and Territories. Depredations by a bark beetle on the Silver Pine, Red Fir, and Lodgepole Pine in the Priest River Forest Reserve in Idaho, and by an important wood-boring enemy of the Red Fir near the Olympic Forest Reserve in Washington, were investigated.

An important result of the work of the year was the determination that the destruction of many large areas of timber, which was supposed to be the result of forest fires, was primarily the work of insects, the insects having killed the timber, which then offered favorable conditions for the starting of extensive fires. A serious trouble affecting the pines in the Rocky Mountain region from Arizona to Idaho, caused by bark beetles and which resulted in the death of a vast amount of timber in the National reserves and on public and private lands, was also investigated.

Many other similar investigations were carried on, and the most encouraging progress was made in the attainment of the principal object of the work, namely, the discovery and practical application of methods of preventing losses from the ravages of forest insects. The recommendations for checking the rapid spread of pine-destroying beetles in the Black Hills were adopted by the General Land Office of the Department of the Interior with good results, as were also recommendations for the control of the serious insect trouble affecting the pine timber on some 200,000 acres of forest and ranch land in northeastern New Mexico.

Three field stations were established, one in the Black Hills, one at Tryon, N. C., and one at Hoquiam, Wash.

WORK ON THE CODLING MOTH IN THE NORTHWEST.

This work, which has been referred to in previous reports, was completed during the autumn of 1902. The special agent in charge during the following winter completed a full report on the investigation, which indicates very satisfactory results. Demonstration on a large scale of the efficacy of the measures adopted and recommended showed to the satisfaction of all concerned that the economical control of the codling moth in the Northwest is possible. It was conclusively shown that in the infested regions of the far Northwest from 85 to 100 per cent of the fruit was injured if no remedial measure was used, but that on intelligent application of the remedies advised by the Division of Entomology from 85 to 98 per cent of the fruit might be saved.

OTHER INVESTIGATIONS.

The work upon injurious scale insects has been carried on through the year. The methods of controlling the San Jose scale have become

more effective, and the advice issued by the Division of Entomology is embodied in two recently published and revised circulars giving the latest methods of control. Much work was done in the determination of scale insects for experiment stations and individuals, including the study of considerable material received from foreign sources, and especially from our new possessions, Porto Rico and Hawaii.

The investigations of insects injurious to truck crops have been carried on, and a special study has been made of those forms which injure the sugar beet.

The work on insects injurious to stored products has also been measurably successful, and the remedies proposed for this class of insects have been successfully tried by many individuals. An especial study has been made of the injuries of the so-called powder-post beetles to the wood used in making agricultural tools and furniture.

The insects affecting ornamental plants have also been studied to advantage.

The investigations of insects in their direct relations to the health of man, which have been under way for two years past, have been continued. Careful studies have been made of the habits and geographical distribution of the mosquitoes which convey malaria and those which convey yellow fever. An extensive investigation of the insects attacking the stems of growing wheat, rye, barley, and oats, not, however, including the Hessian fly which was earlier dealt with, has been completed during the year, and a final report prepared for publication.

The insects which affect mushrooms, the gadflies or horseflies, the insects which affect the seed of the clover plant, and the insects which affect the cranberry have been studied during the year and are being written up.

The work on insects affecting shade trees, which has been carried on now for several years, has been continued, and the preparation of an extensive bulletin on this subject is under way.

WORK IN SILK CULTURE.

An appropriation of $10,000 to the Department of Agriculture for investigations in silk culture was made by Congress for the fiscal year 1903. The conduct of this investigation was placed in the hands of the Entomologist. Previous work by the Department in the years 1882 to 1891 had already demonstrated the possibility of raising excellent cocoons of the domestic silkworm in all parts of the United States in which the White Mulberry tree will grow. Therefore, in the investigations to be undertaken at this time, the whole attention of those in charge is naturally devoted to the main practical aspects of establishing the industry. Undoubtedly the first steps are to create a general interest in the subject, to insure the supply of leaves for

food for the worms, and to educate as many persons as possible in the care of the worms, so that a crop of cocoons will be assured to any individual or company desiring to go into the reeling business. The Entomologist, during the summer of 1902, visited the silk-growing regions of Europe and investigated the establishments for the selection of pure eggs and also investigated the communities in which silk culture has its strongest hold. He also contracted for the purchase of two four-basin reels. Considerable quantities of silkworm eggs of the best races were purchased, and mulberry seeds and cuttings of the best varieties were also contracted for.

During the winter and early spring eggs were sent in small quantities to all applicants who were able to assure the Department that they had at hand a proper supply of food for the worms. To those who had no food mulberry cuttings were sent. A small crop of cocoons was raised at the Department in the spring of 1903. Nearly all of the persons to whom eggs were sent reported that they had been able to rear the worms and produce the cocoons without great difficulty, and letters were sent informing the raisers that their cocoons would be purchased by the Department at the current European market rates. One of the reels imported from Europe was put in operation at the Department of Agriculture, in Washington. Two expert reelers were secured from France, and at the close of the fiscal year reeling operations were about to begin. The second of the four-basin reels was loaned to The Seri-Culture and Manufacturing Company, at Tallulah Falls, Ga., where extensive planting of mulberry trees has been carried out and where experimental work is promised.

The establishment of the silk industry in the United States must be a matter of extremely slow accomplishment. Small appropriations by the General Government will assist in the education of an increasing class of silk raisers. The lack of a market for cocoons is the great difficulty at the present time. The limited market created by the Department out of this small appropriation is in reality an artificial one. It is necessary, however, to induce people to continue their interest in the subject and to educate a class of silk raisers, and for the present this method will be continued.

APICULTURAL INVESTIGATIONS.

The correspondence in relation to apicultural matters has been constantly increasing, and has covered a wider range of subjects.

In the autumn of 1902 a trip was made by the apicultural investigator through Nebraska and Colorado for the purpose of investigating certain conditions, especially in Colorado, regarding natural and artificial bee pasturage and the early breeding up of colonies of bees to enable bee keepers to take full advantage of the first crop of alfalfa.

The recommendations made to cultivate early pollen-bearing crops, such as Russian hairy vetch, and to employ more prolific, hardy, and strong-winged bees than Italians, such as the Carniolan and Cyprian races and their crosses, have, wherever followed, resulted in a marked increase in the honey yield and in earliness and size of swarms.

A number of queens of select breeding have been sent this year, as in the past, to experiment stations engaged in apiarian investigations, and for testing in sections where it seemed advisable to try certain breeds or crosses.

A race of bees little known in this country, the Caucasian, native to the southeastern provinces of Russia, bordering on the Black and Caspian seas, has been under observation. It promises to be a valuable addition to the varieties already bred in this country. The workers are good honey gatherers and most remarkably gentle. The queens are quite prolific. The exact status of the race as regards hardiness has not yet been determined, although in Colorado they have not seemed inferior in wintering qualities to the Italians already there.

EXPERIMENTAL WORK WITH INSECTICIDES.

The value of the standard insecticides, both for biting and sucking insects, including food poisons and substances which kill by contact merely, has been established by many years of experiment, but nevertheless, by the practical work of the Division of Entomology, such standard insecticides receive each year the indorsement of additional satisfactory experience. This applies not only to the control of insect enemies of field and garden crops and fruits, but also to house pests, as illustrated by additional practical work done during the year with the hydrocyanic acid gas treatment of houses described in the last annual report. The experimentation with petroleum oils, referred to in the former report, has been started during the present year in conjunction with the Bureaus of Plant Industry and Chemistry of this Department. This work, it will be recalled, was undertaken in response to special requests from the Society for the Promotion of Agricultural Science and from the Association of Economic Entomologists.

BIOLOGICAL SURVEY.

The Biological Survey is engaged in three distinct lines of investigation, each of which is as important and independent as the usual work assigned to a division of the Department. These lines consist of (1) the mapping of the boundaries of natural life and crop zones of the country, from which may be determined the agricultural products suitable to the different climatic conditions that prevail in different parts of the country, and so likely to be a commercial success; (2)

investigation of the economic relations of birds to agriculture and horticulture, in order to determine what birds are useful and what injurious to these interests and to what extent; and (3) the preservation and introduction of game, and also the supervision of the importation of foreign birds, to prevent the introduction of undesirable species, such as have caused much damage in other countries or are likely to become pests in this country.

DETERMINATION OF LIFE AND CROP ZONES.

In determining the feasibility of profitably raising a certain kind of crop for market the first question presenting itself is, Is the climate suitable? This question is largely determined by biological surveys or the investigation of the geographic distribution of plant and animal life. Lines are run through a State wherever necessary, and the plant and animal life and effects of physiographic and climatic conditions are carefully noted. From these lines maps can be made, showing the location throughout the State of life zones—in other words, belts that are adapted climatically to certain crops.

During the year the survey of Texas has advanced to such a point that a little additional work will permit the mapping of the life and crop zones and the publication of a full report of the biological character of the State. This survey should obviate many expensive agricultural experiments.

California presents peculiar difficulties to this work owing to the great diversity of climate found throughout the State, ranging from the Alpine summits of mountains, with their perpetual snow, to torrid deserts, hotter and drier than those of Africa, and including regions where frequent fogs and heavy rains prevail. The enormous agricultural interests of California, with its shipments of more than $60,000,000 worth of vegetable products annually, add materially to the value of the final result. As soon as available funds and the difficult character of the country will permit, a biological map of the State will be published, which, it is believed, will be of inestimable service to agriculturists and horticulturists of the State.

It is very desirable to secure as much information as possible concerning Alaska, in view of the tide of immigration setting in toward that Territory and its consequent development. Work was carried on at several points in the Territory, choice being made of such as would yield the broadest possible results with the limited means available for the purpose. The base of the Alaska Peninsula, on both coasts, and several of the lakes and rivers of the interior, notably Lakes Iliamna, Clark, and Becharof, and the Chulitna, Nushagak, and Ugaguk rivers, were the field of exploration. This region is one of unusual importance for biological investigations, as it includes the northwestern limit of the Pacific coniferous forest and is the point of junction of several life areas.

ECONOMIC RELATIONS OF BIRDS TO AGRICULTURE.

The study of the relations of birds to agricultural interests was continued under the two lines that have heretofore occupied attention, namely, laboratory work and field investigation. In the laboratory attention was mainly directed during the past year to the stomachs of game birds, in preparation for issuing a report upon their food habits, in order to meet a constantly growing demand upon the subject.

Field work included a continuation of investigations on a certain Maryland farm, which formed the subject of one of the bulletins of the Division issued during the year, and the study of the food habits of birds in the principal fruit-growing districts of California, begun in 1901. The California work, as noted in previous reports, has yielded important results, which will be very useful to horticulturists by making it apparent which birds are serviceable and which are injurious to their interests.

Complaints have been received by bee keepers in California of great harm to their business, caused by certain birds, which, it is alleged, destroy large numbers of worker bees. Partial investigations of this complaint do not sustain these charges, but further study is necessary before a final report can be made.

In many parts of the country serious loss is entailed on agriculturists by periodic invasions of noxious insects. When such outbreaks occur hereafter they will be investigated, if practicable, by this Division in conjunction with the Division of Entomology, in order to ascertain, as far as possible, what influence is exerted by birds in checking the increase of the pests and thus diminishing the extent of their ravages.

GAME PROTECTION AND INTRODUCTION.

ENTRY OF FOREIGN BIRDS AND ANIMALS.

The duties assigned to this Division relating to game protection are based on three acts of Congress—the Lacey Act of 1900, the egg act of 1903, and the Alaska game law of 1902. The permits required by the Lacey Act for the entry of foreign birds and animals numbered 387 during the year, and allowed the entry of 629 mammals and 53,106 birds. Under the egg act 2,000 eggs of game birds were imported. Importations of cage birds are made mainly at New York and San Francisco, though parrots are frequently entered at New Orleans and different ports of entry along the Mexican border. Pheasants of various kinds for propagation are imported from Canada in considerable number, coming chiefly through the ports of Detroit, Buffalo, and Niagara Falls. The animals that are brought into the country are almost entirely confined to such as are designed for exhibition purposes in circuses and zoological parks. Most of the importations of

cage birds are made by regular dealers, and are subject to the usual inspection. In the case of passengers bringing in a few birds as pets, it has been found desirable to obviate the annoyance sometimes caused by the delay needed to secure permits, and the facilities granted at New York have been extended to San Francisco. Under the arrangement thus made not more than five birds may be declared by passengers with their personal baggage before an officer of the customs and landed without formal permit. A strict account of the birds thus entered is kept by the customs authorities and reported quarterly.

The object of the law is to eliminate the danger of the introduction of birds or animals which might become serious pests. That such danger is constantly present is shown in the history of Australia, Porto Rico, Hawaii, and other countries, and is instanced by the introduction and spread in the United States of the European sparrow, and to a much more limited degree of the Old World starling. Although the entries at San Francisco are few as compared with those at New York, the danger of introducing injurious species at that port is probably greater than at any other. With a view to still further improving the service at San Francisco, a careful examination was made there in June of the peculiar conditions attending importations from Australia and the Orient, which, it is believed, will be productive of much good. It is hoped that all danger of the introduction of such species as may prove to be pests can be eliminated. So far as is known, the law has thus far been effective. Two mongooses from Jamaica were killed at Philadelphia; 1 mongoose from the Philippines and 2 flying foxes from Australia were destroyed at San Francisco; and 50 flying foxes that arrived at New York from Singapore in December were reshipped to Hamburg, Germany.

ENFORCEMENT OF GAME LAWS.

The cordial cooperation of the Attorney-General and State officials has enabled prompter disposition of cases arising from the illegal shipment of birds and game than ever before. Thirty-five such cases, involving the shipment of 3,729 birds, were reported to the Department, a decrease of four cases and about 1,300 birds from those reported during the preceding year. Since the passage of the act 40 convictions have been secured in cases passing through this Department, and about 20 cases are still pending. Efforts have been concentrated upon one or two areas in the West, where illegal shipments seem to be especially frequent, in order to secure more satisfactory results with the limited means available. Illegal shipment of game has been very frequent in the past, and various methods have been adopted to conceal the character of the shipment. The violators of the law have, however, been driven by increasing insecurity in their illegal trade to new devices. Thus, a consignment recently seized in

the Northwest disclosed game birds concealed in bales of hay which had been forwarded by slow freight. In the attempt to curtail these illegal shipments, I have been much aided by the cooperation, cheerfully and cordially given, of express and railroad companies, and there is reason to believe that illicit shipments can, at comparatively small cost, be reduced to a minimum and the great inroads they make upon the game of our country checked.

PROTECTION OF GAME IN ALASKA.

In Alaska, in the absence of a specific appropriation permitting the employment of competent wardens, it has been impossible to secure a reasonable observance of the game law. Much care has been exercised, however, in the case of the export of heads and skins, and the shipment of these from Alaska for purposes of sale in the United States in violation of the law has been practically stopped. Misinterpretation of the statute was the means of temporarily curtailing the trade in black bear skins, but the misconception has been corrected as far as possible.

PUBLICATIONS.

Under the provision of the Lacey Act requiring the collection and publication of useful information relating to the propagation, uses, and preservation of birds, posters and bulletins have been published annually, showing the close seasons and other provisions of the game laws of the United States and Canada, also lists of game officials in the various States, and other information of like character. The digest of game laws was issued as a Farmers' Bulletin in order to meet the demand and to place a sufficiently large number at the disposal of members of Congress. The compilation of laws relating to nongame birds has been of considerable service. Much of the rapid progress in the character of the legislation protecting birds is directly traceable to the dissemination of the information it contains, and it is noteworthy that the adoption of our system of bird protection has recently been strongly advocated in Brazil and Mexico.

RECOMMENDATIONS.

It has been found impracticable to transport, fence, and maintain elk and other animals on forest reserves and other public lands with the appropriation of $1,000 made for that purpose. I have recommended, therefore, an increase of the appropriation to $5,000 for the ensuing year.

The three distinct lines of work assigned to this Division could be conducted much more economically and effectively were the Division reorganized as a bureau of three divisions, each to have charge of one

of these lines, and were a larger amount appropriated for the performance of the work. I have accordingly recommended such reorganization, with an increase of $1,450 in the statutory roll and $12,000 in the lump fund, in order to accomplish this change and meet the greatly increased demands of some of the sections of the Division.

OFFICE OF EXPERIMENT STATIONS.

PROGRESS OF THE EXPERIMENT STATIONS.

The success of the agricultural experiment stations in leading the way to the improvement of agricultural practice on a grand scale is having as one of its effects a closer union between the stations and the farmers in enterprises directly affecting farm methods. This is leading to demands that the stations shall conduct at least a portion of their investigations in a larger and broader way, in order that the results of scientific investigations, whether in the field or the laboratory, may be more definitely and thoroughly applied in practice under the conditions actually encountered on the farm. A good example of this may be found in the recent cooperative experiments conducted by the Iowa Station at Odebolt, Iowa. The proprietor of a large farm at that place desired to know whether or not the by-products of corn, flaxseed, or cotton seed, or some of the prepared stock feeds when fed in conjunction with corn, would give better results than corn alone. He furnished 220 cattle and the corn roughage necessary for conducting a feeding experiment. The Iowa station furnished the by-products and stock feeds and conducted the experiment. The first test gave results indicating that the addition of so-called condimental stock feeds to a corn and wheat-straw ration gave much lower returns per steer than corn and wheat straw alone.

One of the results of the thorough work of the Illinois station on the breeding of corn has been the formation of the Illinois Seed Corn Breeders' Association. The success of this enterprise has been phenomenal. All of the available supply of the improved seed is rapidly disposed of to farmers and much of it is engaged in advance. The work of this station on corn is proving to be far-reaching in its results, not only in improving the general quality of seed corn, but in inducing practical men to undertake the breeding for special qualities—for protein, for oil or for starch—which the station has demonstrated to be entirely feasible. As a recognition of the value of such work, the farmers' organizations of Illinois have rallied to the support of that station, securing last year State appropriations aggregating $46,000 for special investigations and this year nearly twice that amount, or $85,000.

The Minnesota station has been extending its investigations in the breeding of improved varieties of wheat and other kinds of grain,

making thousands of crosses, and, wherever promising new varieties are found, testing them in a large way, both at the station and on hundreds of farms throughout the State.

The amount of data published by the stations on many agricultural subjects is now very large, and the recent attempts which have been made to reduce this material to organized form in order that it may be utilized for purposes of agricultural education have shown that the stations are doing a great work in supplying the materials out of which a definite science of agriculture is being constructed, and on which courses of instruction in agriculture of different grades can be successfully based.

If our stations are to be continued on the broad basis on which they are at present organized they must generally be supplied with larger funds for the general expenses of investigations in order to conduct their work in a thorough and satisfactory manner. The States can and undoubtedly will supplement the National funds more fully as time goes on, but since the results obtained by the stations are in many cases of general value to the agriculture of the United States, it is worthy of consideration whether they should receive additional financial aid from the National Government. This supplemental aid should, if given, be granted under conditions which will insure its exclusive application to meet the expenses of agricultural investigations.

THE AGRICULTURAL COLLEGES.

Special appropriations for the better equipment and maintenance of the agricultural colleges, aggregating more than $1,250,000, have been made by the States during the past year. The movement in the direction of basing the courses of instruction in these institutions more largely on the science and practice of agriculture itself is continuing, and already has resulted in a considerable increase in the number of students pursuing agricultural courses. A special effort is now being made in a number of our strongest agricultural colleges to make their courses more complete by adding systematic instruction in farm mechanics and rural economics. Increasing attention is being given by these colleges to the holding of summer schools, one purpose of which is to prepare teachers for giving instruction in nature study and elementary agriculture in the common schools. The interest in work of this kind is especially strong in the South at this time, as is shown by the large enrollment of teachers in the Southern institutions. The attendance at the land-grant colleges for the year 1902 aggregated 46,699 students, of whom 6,299 were in agricultural courses. The graduates of these institutions in 1902 were 4,443, and since their organization, 50,026.

This Department is cooperating with the Association of American Agricultural Colleges and Experiment Stations in the preparation of

a comprehensive exhibit at the Louisiana Purchase Exposition showing the progress of agricultural education and research in this country.

SECONDARY AND ELEMENTARY SCHOOLS OF AGRICULTURE.

The attendance at the two county agricultural high schools opened in Wisconsin in the fall of 1902 was large, and the interest manifested in these schools was so great that the State legislature at its last session, recognizing the demand for instruction of this grade, made provision for additional county agricultural high schools with State aid. At the California Polytechnic Institute, San Luis Obispo, buildings have been erected and everything put in readiness for opening the school with agricultural courses this fall. The Mount Harmon School, near Northfield, Mass., founded by the late D. L. Moody, has decided to establish an agricultural department and to offer courses of instruction in that subject. The school already has an equipment consisting of a farm of about 1,000 acres, a dairy of about 200 cows, fruit orchards, and a cannery for putting up vegetables. Mr. Harry Hayward, a graduate of the school and for several months past assistant chief of the dairy division of this Department, has been called to the school as director of the agricultural department. This step on the part of one of the largest secondary schools of the United States is a matter of great interest to those who are following the progress of secondary instruction in agriculture, and is especially significant from the fact that the institution is not a technical school and this is the first attempt to establish an industrial course.

The committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations made a report to the convention of this association held at Atlanta, Ga., in October, 1902, in which it showed that courses in agriculture could be introduced into the public high schools without any violent or radical reorganization of existing programmes for such schools.

Many of the officials in charge of our public high schools and elementary schools are also considering the advisability of introducing agricultural subjects into the curricula of these schools, more especially by giving an agricultural trend to nature-study work.

School gardens, meaning by the term flower and vegetable gardens utilized for educational purposes, are found in the East, the Middle West, the South, the far West, and our insular possessions. They are maintained in connection with the kindergarten and with every other grade up to the high school.

This Department has been aiding the school-garden movement in several ways. Through the Bureau of Plant Industry it has distributed special packages of vegetable and flower seeds to a large number of schools, and conducted a number of school-gardening experiments

in cooperation with the schools and charitable organizations of Washington, D. C. Officers of the Department have in several instances volunteered to direct these experiments outside of office hours. One of the most successful of these experiments was conducted on the Department grounds with a class of 30 boys and girls from a near-by school, under the direction of the science teacher in the normal school of the city.

THE FARMERS' INSTITUTES.

In consequence of the action of Congress during the session of 1902-1903, making definite provision for the work of the Office of Experiment Stations relating to farmers' institutes, it has been possible to put this work on a permanent basis and to begin the formulation of a policy regarding its development.

As a result of a civil service examination, Prof. John Hamilton, of Pennsylvania, was appointed farmers' institute specialist. He has been for many years a lecturer and manager of farmers' institutes, and is thoroughly acquainted with their past development and their present needs.

Since the work of this Department relating to farmers' institutes is based on the principle of giving aid to the institutions maintained under the authority of the States, this Department has established the rule of working in this line through the State officers charged with the management of the institutes.

It is difficult to realize the extent and importance of the farmers' institute movement and its vital relation to the successful incorporation of the results of scientific investigations in our agricultural practice. Under present conditions, with the rapid changes in the personnel of our agricultural population and the almost entire absence of agricultural instruction in our elementary schools, it is of the greatest importance that our adult farmers shall receive definite information regarding improved methods of agriculture and the principles which lie at the foundation of progress in agricultural practice.

EXPERIMENT STATIONS IN ALASKA.

During the fiscal year ended June 30, 1903, experiment stations were maintained at Sitka, Kenai, and Rampart, and a new station established at Copper Center, the experimental work for the most part including the growing of cereals and vegetables, methods of reclaiming, draining, and fertilizing land, and the curing and ensiling of crops. The distribution of seed of hardy varieties of vegetables, cereals, and grasses has been continued and extended, and beneficial results have accrued, as is shown by the constantly increasing number of gardens and other plats of ground which are brought under cultivation. The supervision of voluntary observers of the Weather

Bureau in Alaska has been continued as in former years, there now being 20 meteorological stations which report to the experiment station at Sitka.

The new station which has been opened at Copper Center consists of a tract of about 775 acres, situated in the Copper River Valley, a little more than 100 miles from the seacoast. This tract of land has been withdrawn from entry by the Secretary of the Interior and set aside for the use of the station.

At the Kenai station about 15 acres have been brought under cultivation and all the hardy vegetables, buckwheat, oats, barley, and other cereals are readily matured. Additions have been made to the buildings and a beginning made in animal industry. A record was kept of the milk yielded by a cow purchased for the station, which shows that over 29 pounds was produced daily from native pasture grasses during the months of June, July, and August.

At the Rampart station the work begun in 1901 was confined to the growing of a few varieties of cereals, all of which matured finely. Winter rye sown from seed matured in 1901 successfully passed through the winter and matured a crop of fine grain. These results, attained at a latitude of 65° 30′ N., aid in demonstrating some of the agricultural possibilities of the country. Cooperative experiments have been carried on by Rev. C. P. Coe, who is in charge of the Baptist Orphanage at Wood Island, and these experiments have been conspicuously successful. Winter rye, spring wheat, barley, and oats were matured and a good start made with various tame grasses and other forage crops. Hardy vegetables were produced in considerable quantity, a sufficient amount being grown to supply the 40 members of the orphanage and leave a surplus for sale.

At the Sitka station considerable work has been done in finishing the headquarters building and in enlarging the farm buildings. A small nursery has been established, and several hundred apple trees and currant, raspberry, and other shrubs are being grown for distribution when their adaptability has been demonstrated.

During 1904 efforts should be made to reopen and equip the station at Rampart. The conditions here are representative of the largest body of agricultural land in Alaska and embrace many thousands of acres.

At the Sitka station additional buildings are needed, and there is a demand for a scientific equipment, which should include a chemist, a botanist, and an entomologist, with the necessary laboratory equipments for their various lines.

It is highly desirable that work should be taken up with live stock, but at present this can be done only on a limited scale. The special agent in charge of the station has recommended the establishment of a temporary cattle ranch on Kodiak Island with a view of introducing some of the hardier breeds of cattle into Alaska. He believes that

the Galloway breed is adapted to the conditions in that territory and that southwestern Alaska is particularly suited to this investigation. For a number of years Congress has appropriated for the introduction of reindeer into the more northern part of Alaska, and it seems possible that in a similar way provision might properly be made for the introduction of cattle into the southwestern grass region.

HAWAII EXPERIMENT STATION.

The work of the Hawaiian Agricultural Experiment Station has been continued along the various lines of investigation previously described. Additional portions of the station land have been brought under cultivation, and additions have been made to buildings, fences, irrigation plant, etc., as occasion required and funds permitted. A special effort is being made to build up a working library, and the special agent in charge has contributed his private collection as a nucleus for a station library. The necessity for a well-equipped economic library is peculiarly felt in a region as isolated from library facilities as is this station.

During the past year a number of bulletins have been issued, giving the results of investigations which have thus far been carried on. The experiments begun in the previous year on taro rot and potato rot have been continued on an enlarged scale, and the results already obtained suggest the practicability of combating these diseases. One of the most destructive diseases of the taro may be prevented by proper attention to the irrigation water and to the application of suitable fertilizers. The potato experiments have been continued, and it is found that one form of rot may be successfully combated by the thorough use of Bordeaux mixture, and preliminary experiments seem to indicate that a second disease, which is due to a soil fungus, may be prevented to a very great extent by soaking the seed tubers in a solution of formalin and planting them in uninfested soils. These experiments are to be continued for a number of years in the hope that the results obtained in the preliminary investigations will be confirmed.

Formerly, the growing of corn was an important industry in Hawaii, but through careless methods of cultivation and the attacks of insects the growing of this crop has become an uncertain industry. Investigations have been begun by the station in which the effect of deeper plowing, the use of fertilizers, thorough cultivation, and the introduction of new varieties are tested. The preliminary results thus far obtained have given excellent results and two varieties which have been introduced—Leaming and Boone County White—seem to indicate that these varieties are particularly adapted to cultivation in Hawaii and are apparently more satisfactory than the so-called native varieties.

A collection is being made of the grasses and forage plants of the

islands, and it is hoped that a bulletin may soon be issued concerning them, which may contain notes on the native and introduced species, together with suggestions relative to their value for different purposes.

The investigations on injurious insects have been continued, and a serious outbreak of a mealy bug on alligator pears was prevented by prompt action.

The station is devoting considerable attention to the subject of fiber plants, and a bulletin has been issued on the sisal hemp in Hawaii and investigations are being carried on with Manila hemp and other fiber-producing plants.

Experiments with tobacco, especially with Sumatra leaf tobacco, grown in partial shade furnished by light cloth, have been apparently very successful and will be continued upon a larger scale. It is believed that there are a number of localities where Sumatra tobacco can be grown under shade at a decided profit.

PORTO RICO EXPERIMENT STATION.

Since the last report from the Porto Rico Agricultural Experiment Station a permanent location has been secured adjoining the city of Mayaguez and the station removed from its temporary location at Rio Piedras. The farm on which the station is situated had not been in cultivation for some time and a considerable portion of the season was taken up with clearing the land of shrubs and weeds, repairing buildings and roads, constructing fences, digging ditches, etc. As preliminary to planting, a number of acres was sown with general crops in order to bring the soil in condition for experimental purposes and incidentally test the adaptability of the different plants to Porto Rican conditions.

A beginning has been made to establish nurseries of citrous fruits and rubber and tea plants, as well as varieties of mangoes, bananas, and other tropical fruits. Arrangements have been made by which improved varieties of tropical fruits are being secured from different portions of the West India Islands through the courtesy of the commissioner of agriculture for the British West Indies.

Experiments have been commenced to test various fiber plants, and there are now growing at the station manila hemp, sisal hemp, and a number of species of fiber plants which grow upon the island. Experiments are being conducted to test the value of various leguminous crops for restoring the soil, and thus far velvet beans and soy beans appear very promising. Cowpeas, which had been extensively sown, suffered severely from insect injuries. Alfalfa is also being tested with some promise of success.

The coffee investigations of this station have been continued at the coffee plantation La Carmelita. On this estate 10 acres have been placed at the disposal of the station for experimental purposes, and

the effect of different methods of pruning, shading, fertilizing, etc., are being tested.

During the early part of the fiscal year the botanist of the station visited the northeastern part of the island and made a report upon the native forest, which was fast disappearing. Based upon this preliminary survey a recommendation was made to the Secretary of the Interior that a forest reserve be set aside, and in January, 1903, the President proclaimed the Luquillo Forest Reserve of about 25,000 acres.

For continuing the investigations in 1904 the insular government appropriated $2,700. This will be largely expended on permanent improvements and special investigations. Tobacco investigations and a soil survey of the island have been begun, but owing to the small appropriation the work could be but little more than a preliminary survey. It is desired that this work should be continued in cooperation with the Bureau of Soils of this Department, and it is recommended that the present law, which limits the soil investigations to the continental portion of the United States, be amended so as to permit of an extension of the work in both Porto Rico and Hawaii.

The cordial support which has thus far been accorded the station by the insular legislature, together with the interest manifested by planters in requesting its publications and in soliciting specific information, is very encouraging and bespeaks for the station a high degree of usefulness.

INVESTIGATIONS ON NUTRITION OF MAN.

During the last fiscal year the inquiry regarding the food and nutrition of man has been conducted along the same general lines as formerly, and has included studies of the nutritive value and cost of different food materials in various regions of the United States, special investigations with the respiration calorimeter on the transformation of matter and energy, studies of the changes brought about in cooking, the relative digestibility of different food products, and dietary studies.

Meats, legumes, cereals, fruits, and nuts have been the special subjects of the digestion experiments of the past year. The work with meat has included the study of the influence of cooking, as well as of age, breed of animal, etc., upon digestibility. The experiments with cereals have included the effect of the different methods of the milling of flour upon the digestibility of bread made from it.

Cooking experiments have been made only with meat and have included a study of the effect of cooking upon the flavor, palatability and digestibility, beef being usually used for the purpose. Generally speaking, the meat was cooked in a number of ways, the length of time of cooking, the temperature, etc., varying in the different tests. It

was found that the chief loss in weight during the cooking of beef, and doubtless of other meats also, is due to the driving off of water. When beef is pan broiled there appears to be no great loss of nutritive material. When beef is cooked in water from 3 to 20 per cent of the total substance is extracted and found in the broth. The amount of fat thus recovered varies directly with the amount originally present, that is, the fatter the meat the greater the quantity removed. The amount of water lost during cooking varies inversely as the fatness of the meat, that is, the fatter the meat the less the shrinkage due to loss of water. In cooking in water the loss of constituents is inversely proportional to the size of the piece of meat.

Dietary studies have been made in several widely different localities, and have included a study of the amounts of food consumed by people of varying occupations, age, sex, and circumstances. The purpose has been to secure data in regard to the kinds, amounts, and costs of food materials under different conditions, to give an opportunity for comparison with the data obtained by investigators in other countries, and to assist in establishing a general dietary standard. As a whole, the experiments have given valuable results.

In accordance with the usual plan the investigations have been carried on in cooperation with agricultural experiment stations, agricultural colleges, and other educational institutions in different States, including California, Connecticut, District of Columbia, Georgia, Illinois, Maine, Minnesota, and Tennessee.

Nine dietary studies and thirty-one digestion experiments were made with fruits and nuts, these articles in nearly every case constituting all or almost all of the daily fare. The results obtained warrant the deduction that, as shown by their composition and digestibility, both fruits and nuts can be favorably compared with other and more common foods.

IRRIGATION INVESTIGATIONS.

The work of this branch of the Office of Experiment Stations during the past year has included:

The furnishing of information regarding the requirements and possibilities of irrigation, in both the arid region and the East, to a large number of farmers who either contemplate emigrating to the West or adopting irrigation as an aid to agriculture in the East.

The making of special studies and furnishing expert advice to communities about the methods of distributing water to lessen losses from seepage and evaporation, and about the preparation of plans for draining land in both the arid and humid parts of the United States.

The making of original investigations in order to discover the best methods of handling water and thus promote the largest and best development of the country, and to gather the facts needed to answer

the inquiries which come to the Department. These may be grouped under the following heads:

In the acts making appropriations for these investigations Congress has provided that wherever possible the Department should cooperate with agricultural colleges and experiment stations in the several States. Experience has shown that this is a wise provision, as it enables this Department and the State stations to obtain much larger results than would be possible if each carried on its work alone. It is believed that the arrangement is equally advantageous to both parties. In accordance with the provisions of this act we have made arrangements for cooperative work with a number of the experiment stations of the East, where irrigation problems are assuming considerable importance, and with all of the experiment stations of the arid region, except two. In three States special appropriations have been made by the State legislatures to aid in extending this cooperative work. The Department is also receiving appreciated aid from the various State engineers' offices of the arid States.

DUTY OF WATER.

At the outset of these investigations the Department made an extended study of the quantity of water being used in irrigation under existing methods. This knowledge was needed by courts in the establishment of titles to water, by canal companies in planning and operating irrigation works, by farmers in making water-right contracts or in building ditches for themselves, and it was also an indispensable basis for an intelligent effort to bring about a more economical use of water by the improvement of methods, as well as to furnish advice to the large number of persons who each year undertake irrigation for the first time.

The work of the past year and that planned for the future is to promote the adoption of improved methods. It includes the determination of the amount of water needed to give the best results, the time when it should be applied, and the methods of application best suited to different localities and different crops. In this investigation experiments are being made in which the water actually used by plants is being measured. With this as a basis, the additional quantities necessary to supply evaporation and other losses, which are unavoidable under any conditions, can be determined with greater exactness. The same problem is being taken up from the practical side. Experimental fields have been planted. In these fields different quantities of water are being applied to crops where all other conditions are made as nearly uniform as possible. In this way a quantity of water which will produce the largest returns can be determined.

A prominent feature of the reports made by our agents in 1902 is a discussion of the evils resulting from the use of too much water, the

swamping and ruining for the present of large areas which were only a few years ago highly productive farms. The first remedy which suggests itself is to stop using more water than is necessary, and the work of the Department just outlined is for the purpose of determining what is necessary. Farmers can not make these experiments for themselves because they are dependent upon what they grow for a living and must apply enough water to make sure of the crop. It is, therefore, the duty of this Department to make the experiments, and the benefits certain to accrue fully warrant the outlay. The use of water in excess of the needs of crops not only reduces the yields and ruins large areas of fertile lands, but it deprives other lands equally fertile of a water supply. There is an area of approximately 10,000,000 acres now under irrigation, and canals already built cover an added area of at least 5,000,000 acres. Our work in the past leads us to believe that the use of better methods on the areas now irrigated will make possible the cultivation of the added 5,000,000 acres now under ditch with very little added expense for canal construction. Reduction of yields by the failure to use the proper quantities of water is reason enough to justify the work being done on this line, but the damage done by the surplus makes the continuation and enlargement of this work of great public interest.

The work so far outlined deals with those parts of the United States where no crops can be raised without irrigation. Scattered throughout the arid States, and in the regions between the Missouri River and the Rocky Mountains, there are large areas where crops can be raised without irrigation, but where the productivity would be greatly increased by the use of more water and by methods of cultivation which will conserve the supply of moisture which they already have. The agent in charge of our work in Oregon estimates that there are 3,000,000 acres of agricultural land in that State whose products can be greatly increased by the adoption of proper methods for conserving the moisture which falls outside of the irrigation period, and equally good results can be obtained in other States. In Kansas the best methods of utilizing small sources of water supply are being studied, and experiments are being carried on.

SEEPAGE.

Measurements of former years have shown that the losses from canals by seepage are much greater than have been commonly supposed. The Department is carrying on a series of investigations to determine the best means of preventing these losses. Measurements of a large number of canals show that as a rule the greater losses occur in the comparatively short sections. If these sections could be improved, the leakage would be greatly reduced. In many cases irrigators do not make use of more than 50 per cent of the water entering

the headgates. The saving of these waters, therefore, means an increase of more than 50 per cent in the available supply, or the doubling of the area irrigated, but the benefits to come from this saving will be more than this gain in crops and in watered area. Seepage water from canals and laterals not only often finds its way where it can not be available for irrigation, but it also prevents the cultivation of large areas of land through the rise of ground water until the land becomes too wet for crops. This also brings up the alkali which has been dissolved and makes the land still further unfit for cultivation. The facts being gathered enable the Department to advise farmers and canal managers as to the best plans for distributing water to their fields at the least expense and with the least loss.

Leakage from ditches is a very serious question in the extension of irrigation in the eastern part of the United States. It has been found practically impossible to irrigate the sandy lands of Florida by unlined earthen canals, as the water all sinks before it reaches the grounds to be irrigated. There has been a similar experience in both Winconsin and New Jersey, and experiments are being made to determine whether or not some cheap and feasible system of lining canals and distributing water can be found.

DRAINAGE.

Requests from communities for advice about the removal of seepage water have been so numerous during the year that it has been beyond the means of the Department to respond to all of them, and it will be necessary to extend this work in the future. There is a special reason why the Government should lend this aid. The injury to each farmer's land does not come from his own neglect or wasteful use, but from the watering of other areas, which action is being encouraged by the Government, so that the individual settler in many instances is a victim of the country's growth and of a recognized State and National policy.

Numerous requests have also come to this office for advice about agricultural drainage in the eastern part of the United States, and especially in the South and Middle West, where there are large areas of fertile land which, if drained, could be made immensely productive. The drainage of such lands is beyond the means of the individual settler. The public welfare will be greatly promoted by having this work done. Every consideration which justified the extension of aid in the reclamation of arid lands applies with equal or greater force to the furnishing of needed advice about the reclamation and improvement of this overwatered land, because it would have exceptional value. Its fertility has not been exhausted by long cultivation, and it is located where transportation is cheap and where there is direct access to densely populated districts. The farmers are there, the markets are

there, and the soil is there. In the aggregate, these swamped areas have a productive capacity equal to four times the State of Illinois, and the inauguration of their improvement takes rank among the important public agricultural movements of the country.

IRRIGATION IN THE EASTERN PART OF THE UNITED STATES.

Irrigation in the humid portions of the United States is proving profitable and is becoming an important factor in the production of certain crops. The irrigation of rice in Louisiana and Texas has added largely to the prosperity of those States and is being rapidly extended. The methods employed differ widely from those used in rice irrigation along the Atlantic seaboard, and the Department is aiding farmers by gathering data as to the quantity of water needed, the best methods of raising it from streams, the cost of pumps, engines, fuel, the construction of laterals, and time and method of applying it. In the South Atlantic States rice culture is having to contend with some troublesome conditions created by the cutting off of the forests on the headwaters of streams. This has filled river channels with the soil washed from the hillsides, and has forced rice growers to contend with a wider fluctuation in streams. A partial investigation of the problems confronting the rice growers in this section has been made to determine the feasibility of providing a supplemental water supply in times of scarcity and also to advise the farmers regarding the best means of protecting their dikes from floods.

An investigation of the requirements of cranberry irrigation is being carried on in cooperation with the State experiment station of Wisconsin. This investigation includes a study of both the irrigation and drainage requirements of this crop. The success of the cranberry industry depends upon the proper use and control of water. It must be applied at the right time, and it must be withdrawn quickly at the right time. Until the last few years no attempt was made by cranberry growers in Wisconsin to exercise control over the water. If nature failed to cover the vines at the right time or uncovered them at the wrong time the crop would suffer. The severe drought of 1895 almost destroyed the industry in that State. With its revival better methods are being adopted; dams are being built to collect the surface water; canals are being constructed to carry water pumped from streams. The development of the industry and the extension of the area under cultivation have brought new difficulties. More water is needed, requiring larger ditches. Greater uniformity in the matter of drawing off water is imperative to prevent the operations of one neighbor damaging those below him. Much litigation has been caused by a lack of arrangements for cooperation and by the construction of inadequate works. This calls for more knowledge as to the principles

which should govern in this work, which this Department is endeavoring to collect and provide.

The results of the present year, while not conclusive, show how greatly the success of this industry will be promoted by an efficient system of canals for getting the water onto the ground and getting it off. On June 11 of this year there was danger of frost. Those who had proper ditches saved their crops. Those who were not so provided lost them. A conservative estimate of the loss in the Cranmoor and Mather regions places this loss at $25,000. The damage due to improper drains in this region which prevented the removal of the water in time was greater than that from frost, so that from these two items in the two districts there was a net loss this year of over $75,000, a sum which would probably be nearly sufficient to construct a system of canals to meet the demands of both districts.

The severe drought which prevailed in the New England and North Atlantic States during the early part of the present summer not only showed the importance of irrigation to market gardeners and others growing high-priced products in this part of the country, but gave an excellent opportunity for observing the effects of irrigation where it was made use of. The facts regarding the operation of a considerable number of private irrigation plants have been collected and will be published for the information of others wishing to undertake similar work. There were also carried on in New Jersey some systematic studies of the effect of irrigation upon asparagus, other vegetables, and small fruits, and on the sandy lands in the southern part of the State.

FOREIGN STUDIES.

The law requires that this Department shall investigate irrigation methods and laws of foreign countries. A report on Egyptian irrigation has been published, and during the past year a study of the methods of operating canals and distributing water among farmers in Italy has been made. Both of these have shown that foreign countries have many ideas and practices which we can study to advantage, and these studies of foreign systems should be continued until our farmers are informed as to the methods of every country in the world where irrigation is practiced.

AGRICULTURAL ENGINEERING.

Attention has been previously called to the importance to American agriculture of bringing about improvements in our practice along a number of branches of engineering. But so pressing has been the demand for investigation relating to irrigation that it has not been possible, with the funds at the command of the Department, to do any considerable amount of work in other lines of agricultural engineering. The studies in drainage, apart from those relating to irrigation,

which it has been possible to make, have been of great value to a number of districts in the East, and these should be extended.

The studies of pumping should also be extended, in order to answer more definitely the many inquiries which are coming to the Department for information and advice. Already thousands of farmers are pumping water for irrigation and thousands of others are thinking of doing so. They write to this Department asking the amount of water required and the size and kind of pumps necessary to furnish it. It is certain that irrigation by pumping will greatly increase in the future, and the money value to farmers of having pumps operated efficiently will be proportionately enhanced. Pumping is also being used to relieve land which has been injured by seepage, and altogether this field is one of the most promising in which we are engaged, and nothing should interfere with continued work on this line.

While the study of power is being made primarily with relation to its use in running pumps, the information collected will prove useful in other lines of farm work. The long-distance transmission of electricity has made it possible to utilize the power of streams so cheaply that it can be profitably applied to many classes of farm work. Competition makes it necessary for our farmers to adopt every means of cheapening production, and the use of this power for operating farm machinery promises much in this line. Power has been largely used on great ranches, but has not been adapted to the needs of the man who is farming on a small scale and doing his own work. The work now being done by this Department is of especial value to this class of home-making farmers, as it will help to put them in a position to compete with those who can take advantage of the economies made possible by doing things on a large scale.

Closely related to this has been the growing interest in a number of our strongest agricultural colleges in the development of courses of instruction in farm mechanics. The increasing use of large, complicated, and expensive machinery in connection with farm operations has led to a demand on the part of the students attending the agricultural colleges for definite instruction regarding the construction and use of such machinery. Important problems regarding the further application of steam, gasoline, electricity, and other kinds of power to farm purposes are also being brought home to these institutions to solve in the interests of our farmers. The manufacturers of farm machinery, realizing that experts trained in the science and art of agriculture as well as in mechanics and engineering would make their most efficient helpers, are beginning to look to the agricultural colleges for such men. The colleges attempting to establish courses in farm mechanics and other lines of agricultural engineering are immediately made aware of the fact that the data for the scientific and pedagogical basis of such courses are very meager, and they are therefore looking to this

Department to aid them in instituting investigations to supply this information. Since it has seemed to this Department that this field of investigation was clearly within the scope of existing law, it has begun to aid the colleges along this line. With our present resources only a very limited amount of work in this line can be undertaken, and I have therefore recommended that $10,000 be appropriated to enable this Department to extend its operations in agricultural engineering, especially on the application of power to farm machinery.

In order that the work of this Department in lines of agricultural engineering other than irrigation may be more definitely recognized, and organized on a more permanent and satisfactory basis, I recommend that Congress change the wording of the appropriation act so as to make the general title of this division of our work "Irrigation and Agricultural Engineering."

OFFICE OF PUBLIC ROAD INQUIRIES.

The National Good Roads Convention held at St. Louis, Mo., April 27 to 29, 1903, in connection with the opening of the Louisiana Purchase Exposition, was probably the most important meeting of the kind ever held in the United States. It brought together a greater number of influential citizens than any previous road convention. Addresses were delivered by the President of the United States, several governors of States, and members of Congress, besides prominent men engaged in agricultural and commercial pursuits, railway transportation, and journalism.

The work of testing the chemical and physical properties of road-building materials has been continued by the road-material laboratory, which is conducted in the Bureau of Chemistry in cooperation with the Office of Road Inquiry.

COOPERATIVE FIELD WORK.

The cooperative field work of the Office deserves special mention. Work of this kind usually results from an invitation extended to the Director by local or State authorities, an agricultural experiment station, or a good roads association. The Department furnishes only the services of its road experts. The materials are supplied, and the expenses of the work paid, by the other factors in the cooperation. The machinery employed is usually furnished free of charge by the manufacturers, who thereby secure an advertisement of their wares; and the railroad corporations usually transport such machinery free on account of their interest in road improvement as a means of developing the country tributary to their lines. The end in view is the construction of a short section of object-lesson or experimental road. Such work furnishes opportunity to test local road-building materials,

and gives the people of the locality an object lesson in methods of preparing the material and constructing the road; and the finished road serves to teach the worth of a good hard road to all who travel over it. In nearly all cases the value of such work is greatly enhanced by the holding of a convention while the work is in progress. This brings together a large number of persons, who not only secure the benefit of the object lesson, but who listen to addresses on all phases of the road question.

Cooperative field work of the kind just described has been carried on to a greater or less extent during the last five years, and its practical value has been amply demonstrated. It certainly yields a maximum of good results at a minimum of expense to the Government. The Director of the Office has recently secured reports from many localities where experimental road work has been done, and they uniformly show that the work was well done and that the object-lesson roads built led to a general improvement of the roads in those localities. During the past year more cooperative field work has been done than in any preceding year, and the demand for Government aid of this kind is greater than ever before.

For greater convenience and efficiency in carrying on the field work of the Office, the country has been laid off into four main divisions, with a special agent in charge of each.

GOOD ROADS AND RURAL FREE MAIL DELIVERY.

The intimate relation which exists between good country roads and rural free delivery of mail can not be too strongly emphasized. Communities which would enjoy the latter must make and maintain the former. In many instances bad roads have prevented the extension of rural free delivery to communities where it was greatly desired, and in some cases have caused suspension of routes already in operation. The desire for extension of the service should, and doubtless will, act as a powerful stimulus to road improvement in many localities.

The work of the Office of Public Road Inquiries appears to be no longer of a tentative character. Year after year it assumes increased importance and wider scope. That it will be a permanent feature of the Department's work hardly seems open to question.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

The extension and rapid growth in the work of this Department necessitates an increase in the estimates for each year. These estimates are prepared in the Division of Accounts and Disbursements

and transmitted to the Congress through the Secretary of the Treasury, and all expenditures are made under the supervision of that Division. The appropriations for the fiscal year ended June 30, 1903, including $510,000 for deficiencies, were $5,013,960, an increase of $1,091,231.54 over the preceding year. The expenditures during the year amounted to $4,296,882.60, leaving a balance of $717,077.40, but the greater part of this sum is covered by outstanding liabilities.

All accounts for the fiscal year 1901 having been settled, the unexpended balances of appropriations for that year, amounting to $65,127.50, were covered into the Treasury on June 30, 1903.

There was received and deposited in the Treasury the sum of $12,803.56. Of this amount, $4,026.69 were received from the sale of American products in Europe, $382.75 from sales of agricultural products of the agricultural experiment station in Hawaii, $782.45 from the station in Porto Rico, and $548.15 from sales of experimental shipments of fruit to Europe.

The amount paid for rent of buildings in the District of Columbia for the use of the several branches of the Department was $21,700. The amount appropriated for the same purpose for the current fiscal year, 1904, is $27,900, an increase of $6,200.

DIVISION OF PUBLICATIONS.

The work of the Department of Agriculture in all its branches is necessarily reflected in the work of the Division of Publications. As all the other Bureaus and Divisions contribute to the acquisition of information, so the Division of Publications is the channel for its diffusion. Therefore, no possible enlargement of the work of the Department in any particular branch can be conceived of which does not ultimately add to the work of the Division of Publications. It is not within the province of its chief to restrict its work, but only to direct and control it to the best of his ability and with the means at his command. These facts explain quite logically the continued growth in the work of this Division.

Until last year the largest number of publications issued in any twelve-month period was 757 in 1902. The total number of publications issued during 1903, however, was 938. Of the publications issued in 1902, 355 were new. The new publications issued in 1903 amounted to 375, showing that the bulk of the increase in the number of publications issued consisted of reprints, which in turn indicates a continued and pressing demand for the Department publications. While the new publications show but a small increase in number, the number of pages they contain shows an increase of 17 per cent over 1902. The total number of copies of all publications issued during the year aggregated not far from 12,000,000.

The publications known as Farmers' Bulletins seem to satisfactorily supply a widely felt want. Of the total number of copies of all publications issued during the year, nearly 7,000,000 were Farmers' Bulletins, and of these nearly 4,000,000 copies were distributed, as provided by law, under addressed franks supplied by Senators, Representatives, and Delegates.

In spite of the generous supply of publications, it is constantly necessary to refuse requests, owing to the editions being exhausted and means lacking to furnish a further supply. Under these circumstances I have found it desirable to restrict free distribution abroad to Government and other public institutions and to a few persons engaged in lines of work analogous to our own and actually cooperating with us.

The figures showing the number of publications issued and distributed by the Department would suggest to casual observation that the number was amply sufficient to supply all possible demands. Such, however, is far from being the case. A careful consideration of the applications received afford conclusive evidence that only a comparatively limited number of the nearly 7,000,000 farms in the United States are reached by the publications of this Department. This is a matter of regret, as the full value of the information acquired by the Department can unquestionably be realized only by a prompt and widespread diffusion to all those who might be benefited by it. It is a striking evidence of the general appreciation of the information the publications of this Department contain that over 30,000 copies were sold by the Superintendent of Documents in the face of the enormous free distribution, and that official has moreover declared that the number sold would be twice as great were he able to supply the demands. This suggests the desirability of setting aside, to defray the expense of reprints, the sums received by him for publications sold through his office.

The conservative course recommended by yourself in the matter of illustrations has been carefully followed, the rule adopted being to exclude all illustrations not necessary or at least essentially helpful to the understanding of the text. It is impossible for this Department, for reasons sufficiently obvious from what has already been said, to further restrict the output of publications. In view of the increase in the work of the Division of Publications and the causes which promise its continuance in the future, I have felt constrained to recommend some increase in the appropriations for its use.

THE LIBRARY.

The work of the Library increases from year to year with the growth of the Department, and with increased appropriations it is better able each year to meet the varied demands made upon it. The collection of books and pamphlets now in the Library numbers about 80,000, and contains many books and periodicals found in few, if any other,

libraries in the country. Agricultural workers in all parts of the country look to this Library more and more for assistance in the way of loans of books, verification of references, and preparations of subject lists.

ACCESSIONS.

A larger number of purchases have been made during the past fiscal year than in any year previous. Many new scientific serials have been added to the list of subscriptions, and the list of general agricultural, technical, and scientific periodicals acquired by gift and exchange has been largely increased. The present policy of the Department in the distribution of its documents enables the Librarian to arrange exchanges with many foreign as well as American scientific institutions and societies whose publications form valuable additions to the Library.

TECHNICAL WORK.

The Library has continued the publication of its quarterly bulletin of accessions. The recently adopted subject arrangement of the bulletin has proved to be an added convenience for reference use. Beginning with December, 1902, catalogue cards for current accessions to the Library have been printed at the Library of Congress. Extra copies of these printed cards can be purchased at small cost on application to the Librarian of Congress. A reprint of the index cards for the Yearbooks and the Farmers' Bulletins is in progress to meet the demands from the smaller libraries in the country for indexes to these popular publications of the Department. Provision has also been made for extending this index work to include index cards for some of the most important agricultural periodicals. During the past year there have been requests from several agricultural colleges and experiment stations for suggestions and aid in reorganizing their libraries. Assistance of this kind has been given whenever practicable, and the Department will continue such aid to further the organization and development of agricultural libraries.

NEW BUILDINGS FOR THE DEPARTMENT.

It is gratifying to announce that Congress, at its last session, authorized the expenditure of $1,500,000 for the erection of new buildings for this Department. Two hundred and fifty thousand dollars was appropriated to inaugurate the work and as soon as the money became available steps were taken to secure the necessary plans and specifications. At the outset, some difficulties were met in the matter of reaching satisfactory conclusion with the architects. These matters were not finally settled until early in September of this year, when the contract for the preparation of plans and specifications was awarded to the firm of Rankin, Kellogg & Crane, architects, of Philadelphia.

The Department is now occupying 137,963 square feet of net floor space, 75,771 square feet of which is in rented buildings. In order to accommodate the present needs of the Department alone this amount of space would have to be increased fully 25 per cent. The Department of Agriculture is different in its requirements, so far as buildings are concerned, from other branches of the Government. Our work is largely of a research nature. Laboratories, therefore, are essential and form a considerable portion of the room required. A committee of Bureau chiefs in the Department, consisting of Doctors Galloway, Salmon, and True, has given careful consideration to the varied needs and have made recommendations, which I approve, that the best interests of the Department will be subserved by providing for a series of buildings connected with pavilions in such a way as to make practically one harmonious structure. The chief advantage of this plan is that it can be laid out in such a way as to be added to indefinitely from time to time, as the needs of the Department grow. These ideas formulated by the committee have been further developed by the architects, with a result that a series of buildings has been designed, the central feature of which is an administrative structure. Grouped about this are laboratory buildings to be used by the large Bureaus in their research work.

The scheme, as a whole, provides for the erection of ten buildings, all suitable for the class of investigations which the Department must necessarily carry on. The amount authorized by Congress will suffice for the erection of three of the laboratory buildings, but it will not be sufficient for the erection of the administrative structure. The three buildings will have in them floor space of 100,000 square feet and will enable the Department to comply with the law, in so far as bringing within these structures all those branches of the Department that are now paying rent. The three buildings contemplated will be completed within the appropriation authorized according to the estimates secured at the present time.

CRISIS IN COTTON PRODUCTION.

The invasion of the cotton boll-weevil has been a special menace to our cotton crop, and has done more than anything else to awaken widespread apprehension as to the future of this most important crop. The boll-weevil first appeared in the State of Texas in 1894, and from that time on has been under observation and investigation by the Department through its Division of Entomology. It was not until 1902, however, that this branch of the Department was able to undertake anything like thorough and systematic work in the matter of studying this very destructive enemy of cotton. In 1903 the scope of the work was further enlarged, an appropriation of $20,000 being made in the Division of Entomology for the investigations. Aside from

this work the Bureau of Plant Industry has, during the past year, been carrying on considerable work with a view to securing, if possible, early and resistant varieties by breeding and selection; and has been conducting some more or less general experiments in the matter of crop diversification at special points in Texas. It has also been engaged in distributing a considerable quantity of cotton seed of early-maturing and promising sorts.

The work of the Division of Entomology has shown conclusively the value of good cultural methods, the planting of early-maturing varieties, and the destruction of weevil-infested material, this conclusion having been reached only through the careful and detailed studies of the life history and habits of the insect. The demonstration work along these lines, which the Division carried on the past year, has been exceedingly promising, as it has been shown that cotton can be grown in remunerative quantity, despite the presence of the weevil. Notwithstanding what has been accomplished by the Department, however, the fact remains that the boll-weevil is constantly spreading north and east, and it is probably only a question of time when it will reach all of the cotton-growing States. Thus the country is confronted with a very grave problem, as the invasion of this insect must necessarily mean a complete revolution in present agricultural methods. During a recent visit to some of the Southern States considerable time was spent in the weevil-infested district, and from the facts gathered in this way I am convinced that energetic measures must be adopted to meet the present emergency. After thoroughly canvassing the situation with representative men in Congress and with others, I am of the opinion that a cotton investigation fund should be appropriated and set aside for immediate use in connection with this most serious problem. In order to make the work comprehensive and thoroughly effective, I am of the opinion that a sum not less than $500,000 should be made immediately available for this purpose, the same to be expended under the direction of the Secretary of Agriculture, in such manner as will give the most immediate practical results. As to the problems which might be handled by the Department with such a sum available, I would respectfully call attention to the following:

RECOMMENDATIONS.

1. Checking Sporadic Outbreaks of the Weevil.—It would seem highly important that some action be taken looking to the checking, if practicable, of sporadic outbreaks of the weevil in the territory immediately adjacent to that now infested. This could best be accomplished by the organization of a corps of competent entomologists and could be carried on in cooperation with the State authorities. In order to make this work thoroughly effective it will be necessary for the States interested to enact proper legislation. This is a matter that

could be handled and guided by those in authority, working under the direction of the Secretary of Agriculture.

2. DEMONSTRATION WORK TO SHOW THE VALUE OF IMPROVED CULTURAL METHODS BY WHICH FARMERS CAN PRODUCE FAIR CROPS IN SPITE OF THE WEEVIL.—This is the most promising field for immediate relief, and owing to the fact that the weevil is so far confined to Texas, the work here outlined would necessarily be limited more or less to this State, although regions in adjacent territory should also have such investigations carried on in them in order that the people may become enlightened in advance of the insect's ravages. The object and scope of the work would be to show by actual demonstration experiments the value of better cultural methods, the value of early maturing varieties, and the value of and necessity for complete and thorough destruction of all infested material. To carry out this work thoroughly and effectively would require a corps of men familiar with cultural conditions, and who have the knowledge and ability to direct the necessary specific work that might be ordered by the Secretary of Agriculture. Legislation would be required in this case, also, to enforce the destruction of infested material; but, under proper organization, this could be brought about.

3. WORK HAVING FOR ITS OBJECT THE PRODUCTION OF NEW, EARLY, AND IMPROVED VARIETIES OF COTTON.—The value of early varieties has been demonstrated, but most of them have serious drawbacks in that they are poor yielders and the lint drops out easily during storms. These matters may be corrected by proper breeding and selection, and one of the important problems would have for its object the taking up of this work on a systematic scale, to the end of securing sorts which would not only be early, but would be storm-proof and resistant.

4. STUDIES OF COTTON DISEASES.—While the boll-weevil is mainly in the public eye at present, the fact remains that other serious pests of cotton cause great losses annually. It is natural to attribute all losses at the present time to the insect in question, whether these losses be from other insects, diseases, floods, droughts, or whatever source. Reliable studies indicate that the loss in Texas alone from the so-called root-rot disease will, in all probability, aggregate several millions of dollars annually. This and other diseases should be thoroughly studied, and corrective measures should be adopted.

5. COTTON INSECTS.—What is said of cotton diseases is also true of cotton insects (especially of the boll-worm) other than the boll-weevil. These should all receive careful attention, and practical experiments should be carried on with a view to lessening the injury caused by them.

6. INTRODUCTION OF NEW CROPS.—The urgent necessity for the introduction of other crops which will take the place of cotton can not

be too strongly emphasized. Cotton, of course, should be grown, but the time is evidently at hand when a concerted effort should be made to bring about a change in Southern agricultural conditions in the direction of greater diversification. This is recognized now as a vital question in the South. In many sections already the yield of cotton is barely profitable, so that, when the reduction due to the boll-weevil and other pests is taken into account, it will be necessary to abandon cotton growing altogether; while the decreased yield in the best districts of the cotton-growing sections renders it more important that other crops should be grown. Such crops as alfalfa, sorghum, Kafir corn, and cereals of various sorts should all receive attention, not only for silage, pastures, and winter forage generally, but for green manures as well.

7. Studies and Experiments in Connection with Methods for the Destruction and Control of the Boll-Weevil, and Other Cotton Insects.—It would seem highly important that the Government should take cognizance of the many devices which are being placed on the market for combating the weevil and other insects. This is necessary, as much for positive as negative results. Hundreds of devices and nostrums are offered to the public, and people are led to spend money for them. The Government should be in position to determine, once for all, the value or nonvalue of such devices, and thus be able to definitely and positively advise on all matters of this kind. Aside from this, the Government should take the matter of mechanical devices under thorough consideration, and should encourage, by the utilization of mechanical experts, the construction and use of everything which gives promise of practical value.

8. Studies of Enemies of the Insect.—While the studies of the enemies of the insect have had, so far, no practical result, there is no doubt that this work should be continued, and everything in the nature of enemies, whether they be predaceous or parasitic insects, birds, fungus parasites, or others, should receive careful attention.

9. Securing and Distributing Seed of Cotton Known to have Special Value for Earliness and Ability to Resist the Weevil.—Systematic action should be taken in the matter of securing from every source available seed of promising varieties and thoroughly testing them in the weevil-infested district. In addition to this there should be a systematic endeavor to bring together desirable varieties from all available sources for advance trials in the sections where the insect is likely soon to make an invasion.

10. General Propaganda.—Under this head there should be organized a competent corps of efficient workers, who could, with the cooperation of the agricultural colleges, farmers' institutes, State boards of agriculture, and all such organized bodies, bring to the

attention of planters everywhere the latest results as to methods of meeting the present emergency.

To carry out the foregoing work effectually, it is believed that the best results will be secured by a separate organization. It will be seen that the two branches of the Department primarily interested in this matter are the Bureau of Plant Industry and the Division of Entomology; and their officers and men would be in position to effect the proper organization and to direct the main features of the work. I would, therefore, respectfully recommend that, if the amount already mentioned be set aside as a cotton investigation fund, the Secretary of Agriculture be authorized to take such steps in the perfecting of a proper organization for handling the work as, in his judgment, may be best. Owing to the very nature of the investigations, and the fact that they will involve most thorough and far-reaching scientific work, the management of the general plans must necessarily rest with the Department. It is believed that the work can be strengthened by securing the advice and cooperation of one or two thoroughly practical men in the States most directly interested, viz, Louisiana and Texas. The Secretary of Agriculture, however, should have full authority to organize the work for the sole object of securing, as already indicated, the most immediate practical results.

In order to more effectually handle the problems which must necessarily fall to the work of the Division of Entomology, I have already recommended in my estimates that this important branch of the Department be made a bureau. The work that it has done in the past, especially in the field in question, certainly justifies this action; and I most earnestly recommend that this matter be given primary consideration in connection with the entire problem. It is very desirable, furthermore, that the fullest cooperation be effected by the Department with the experiment stations in the respective States, where the more important work will be conducted. This is especially true of Texas, where the agricultural college is doing everything in its power to aid in the matter, but where it is more or less handicapped by lack of proper facilities and funds.

The fund recommended to be set aside for the purposes mentioned, and used in accordance with the plans outlined, will give the Department such liberty of action as the exigencies of the case demand. An industry which brings to the country an annual income of something over $500,000,000 is threatened, and the time is at hand for energetic action. I again, therefore, most earnestly renew my recommendations for the means and authority to carry out the plans as herein set forth.

Respectfully submitted.

JAMES WILSON,
Secretary.

WASHINGTON, D. C., *November 28, 1903.*

WEATHER BUREAU STATIONS AND THEIR DUTIES.

By JAMES KENEALY,
Local Forecaster, Weather Bureau.

INTRODUCTION.

The popular interest felt in the Weather Bureau, and the increasing attention given to the subject of meteorology, suggest that many readers may desire to become more intimately acquainted with the nature of the daily duties performed by observers at the various meteorological stations. This article has been prepared especially for the information of the large class of readers who know little or nothing of the history and work of the Weather Bureau, and who have had no opportunity to visit a Weather Bureau station for the purpose of obtaining information regarding the character of the duties there performed.

ORIGIN AND DEVELOPMENT OF THE METEOROLOGICAL SERVICE.

The invention of the thermometer and barometer by Galileo about the year 1600 marked the beginning of accurate meteorology and of the scientific investigation of the atmosphere. But it was not until 1848, when the successful operation of Morse's electro-magnetic telegraph was fully demonstrated and meteorology had further developed, that the feasibility of a storm-warning system, based upon telegraphic reports of meteorological observations, was announced both in Europe and in America. Within the next thirty years meteorological services were organized by most of the civilized nations of the world.

The American system of simultaneous meteorological reports by telegraph, on which are based the daily forecasts and storm warnings of the Weather Bureau, was developed in 1870 under the authority of an act of Congress, and for the specific purpose of affording protection to the commerce of the Atlantic and Pacific coasts and the Great Lakes. On November 1, 1870, twenty-four stations began the regular transmission of meteorological observations by telegraph to the Washington office, and a few days later the new service, then a branch of the Army, under the direction of Gen. Albert J. Myer, telegraphed its first storm warning. This was sent to points along the shores of the Great Lakes. The system of displaying storm warnings by means of flags and lights was first put into practical operation about a year later,

when, on the night of October 26, 1871, the first storm-warning light was displayed at the port of Oswego, N. Y. As affording some idea of the expansion of the service since those days, it may be mentioned that the number of storm-warning display stations on the Atlantic and Pacific coasts, the Gulf of Mexico, and the shores of the Great Lakes has been increased from about 25 to about 250, and that the number of regular stations of observation and telegraphic reports has been increased from 56 to about 180. The development of the service has been far more remarkable in other respects, such as the inauguration of new fields of work; the system of distribution of cold-wave warnings; the flood-warning system; the system of collating and distributing reports of the condition of crops; the system of frost warnings; the special forecasts for the benefit of outgoing trans-Atlantic steamers and the marine interests of the Great Lakes; the extensive display of forecast cards, weather maps, and climate and crop bulletins in all the States and Territories; the issue of snow and ice charts and other publications of immediate practical utility, and the enormous increase in the amount of information given to the public by means of the telegraph and telephone. In the success of its work along these lines the Bureau takes much pride.

The causes of these extensions are not far to seek. Everywhere the probable weather conditions from day to day are matters of general concern, and the anxiety occasioned by such unwelcome phenomena as cold waves, droughts, storms, frosts, and floods, with their destructive effects on agriculture and on commercial and manufacturing interests, is shared, in a measure, by every individual in the communities affected. With the steadily growing enlightenment of the public on the subject of meteorology, and the consequent appreciation of the difficulty of the problems with which the forecaster has to deal, there is less disposition to criticize an occasional failure, and the practical utility of the forecasts is more generally appreciated from year to year. Moreover, the expansion of the service during the last few years may be attributed, in no small degree, to the increasing industrial activity of the nation, for every extension of railroad and telegraph lines creates new demands upon the service by enabling it to reach new communities with information that could not otherwise be furnished in time to be of benefit.

THE DAILY WEATHER FORECASTS.

Among the great number of people who read the forecasts issued daily by the Weather Bureau, it is generally known that storms, cold waves, and other phenomena move from one region to another in obedience to physical laws; also that the forecasts are based on atmospheric conditions which are shown by the readings of the barometer, thermometer, and other instruments, and are reported by telegraph

from the place of observation to the forecast center. There are, however, many intelligent persons who entertain erroneous and peculiar ideas concerning the nature of the work performed at Weather Bureau stations, and who do not comprehend the magnitude of the working system of the service.

The central office of the Bureau is located at Washington, D. C. Two forecasts are issued daily for each State and Territory, one about 10 a. m.[a] and the other about 10 p. m. Both of the forecasts are based on the telegraphic reports of observations taken two hours previously, the interval being occupied in collecting, collating, and charting the reports, and in preparing and issuing the forecasts. The morning forecasts are made to cover a period of thirty-six hours, or till 8 p. m. of the following day, and are issued from the central office or from certain selected stations designated as forecast centers. The evening forecasts cover the period of forty-eight hours, or till 8 p. m. of the second day after they are issued, and, with few exceptions hereafter noted, always emanate from the central office. Telegraphic reports are received from 180 regular stations of the Weather Bureau situated in various parts of the United States and on the islands of the adjacent seas, and, by a system of exchange, from 3 Mexican stations and 20 stations of the Dominion of Canada. Daily reports by cable are received from the Azores and from several localities in western Europe. The Canadian reports are invaluable to the forecaster, since they often furnish the first indications of marked changes in the weather of the northern half of the United States. Besides the regular stations there are 132 special river stations, 48 special rainfall stations, about 3,000 stations where observations are recorded by voluntary observers of the climate and crop service of the Bureau, and a number of other stations which cooperate with the Bureau, although not under its direct supervision. Voluntary observers receive no pay, but they are furnished with the Weather Bureau publications. They are provided with instruments by the Bureau, and take observations daily at a regular hour. Their instrumental equipment comprises, as a rule, only an instrument shelter, a maximum and a minimum thermometer, a rain gauge, and a graduated rule for rainfall measurements. Their records of observation show, for each day, the highest and the lowest temperature, the rainfall, the percentage of cloudiness, the direction of the wind, and the occasional special phenomena observed. These data are sent regularly to the climate and crop section centers of their respective districts or States, where weekly or monthly bulletins are compiled and published for the information of those especially interested in crop conditions.

[a] Seventy-fifth meridian standard time, which is used in all references to time in this article.

WEATHER BUREAU STATIONS.

The number of regular meteorological stations of the Weather Bureau at the present time is, as has been stated, about 180. Each is in charge of a trained observer of long experience, who is commissioned by the Secretary of Agriculture, on the recommendation of the chief of the Bureau, at a fixed annual salary. These stations have a far more complete equipment of instruments than is furnished to voluntary observers. The number of stations is much smaller in the West than in the more thickly populated East, since in their geographical distribution due consideration must be given not only to obtaining the fullest possible information regarding general atmospheric conditions over the United States, but also to the most effective distribution of information to the general public. Nearly every important city has its Weather Bureau station.

OFFICES AND INSTRUMENTS OF THE STATIONS.

The stranger in any of our large cities who wishes to visit the Weather Bureau office is directed to a building several stories high, on the top of which, far above the din and bustle of the street, may be seen the busy instruments securing a record of the ever-changing elements. The elevator quickly takes the visitor to the floor on which the office rooms are located. There he will be courteously received by the official in charge or by an assistant, who will gladly be of service if the caller comes after the morning map has been issued, when the pressure of office duties is not too great. Perhaps the visitor is already familiar with some of the instruments, but it may be necessary to explain the mercurial barometer and the principle employed in its construction. The vacuum above the mercurial column will be pointed out, and the visitor will learn that the higher the instrument is taken the shorter will become the column of mercury in the tube, because of the diminishing air pressure upon the surface of the mercury in the cistern, and as a consequence of the fact that the column of mercury in the tube is in equilibrium with the weight of the air pressing on the surface of the cistern. He will be told of the marked changes in the barometer during the passage of storms, and will learn something of their causes. He will be shown the quadruple register, and will be surprised to learn that it is recording on a sheet of paper during every hour and minute of the day just how fast the wind is blowing and from what direction; also whether the sun is shining or whether rain is falling, and if falling what the rate has been for any given time. He will note how the four hemispherical cups of the anemometer are driven around by the wind, and how this instrument counts off each mile of wind. The various parts of the quadruple register will be explained to him. He will learn how the electric

wires are connected and extended to the instruments that are exposed to the free movement of the air above the roof, and how the roof instruments themselves are enabled to telegraph the story of the outside conditions through the medium of the wires and by aid of the clockwork that moves the sheets of paper containing the record. If the station is provided with a telethermograph, the visitor will be surprised by the ingenious mechanism employed in this instrument, which transmits from the roof down to the office the report of the temperature of the outside air from minute to minute and from day to day. He will be interested in the thermometers of the office exhibit equipment, which are of the same pattern as those in actual use above the roof to show the temperature of the outside air, namely, the dry and wet bulb thermometers, by means of which the current temperature, the relative humidity, the dew-point, and the evaporating power of the air are determined, and the maximum and minimum thermometers, which furnish the official record of the extremes in temperature during each twelve-hour period. He will see the barograph, which, as he observes, is continuously registering on paper the weight or pressure of the air, and the sunshine recorder, which automatically registers on the sheet of the quadruple register the duration of sunshine. If not familiar with the weather map or with the way in which the telegraphic reports of observations are enciphered and transmitted by means of the telegraphic circuit system, he will hear a brief explanation of these matters, and others of possible interest.

If the weather is not stormy, the visitor may desire to inspect the instruments on the roof. There he will be further interested to observe how the objects sought to be attained in the exposure of the instruments have been effected, after much careful thought and study, by the use of many ingenious devices. He will observe that the thermometers are exposed in a large wooden box, with slanting roof and louvered sides, standing on a support above the roof. This shelter, while affording a free circulation of air about the thermometers, protects them from rain and snow, from the direct rays of the sun, and from heat radiated or reflected from the roof of the building. This method of exposing the thermometers is in use at all stations. All the instruments are received from the instrument division at Washington, after a thorough test as to their accuracy. The visitor will doubtless examine with interest the instruments used for collecting and measuring rainfall and snowfall. He will note that the self-registering rain gauge measures off each one-hundredth of an inch of rain as it falls, and that this measurement is by electrical means automatically recorded on the sheet of the quadruple register in the office below. After an inspection of the instruments the visitor will comprehend why Weather Bureau offices, in order to secure an unobstructed exposure of the wind vane, anemometer, etc., must have

roofs higher than the adjacent buildings. In some cities he will find that the forecast of the weather and temperature expected for the following day is announced from the roof of the office building by the display of flags and pennants having a distinctive meaning; in other cities he will learn that two display staffs are used, as occasion may require—one for the cold-wave flag and the other for storm-warning flags and lanterns. If the visitor desires further information as to Weather Bureau work, his attention will be invited to the weather map and other publications of the Bureau. Weather Bureau offices are open to the inspection of all visitors.

GENERAL MANAGEMENT OF THE STATIONS.

The general management of the affairs of the Bureau is directed from the central office at Washington, D. C. The chief executive is Prof. Willis L. Moore, who is assisted by the assistant chief, the chief clerk, and a staff of meteorologists and chiefs of divisions. The great amount of labor incident to the supervision of all stations in the service necessitates the employment of about one hundred and eighty persons, chiefly clerks, in the various divisions of the central office. The nature of the duties performed in the central office is suggested by the names of its divisions, which are as follows, namely, chief clerk's office, forecast division, division of records and meteorological data, climate and crop division, instrument division, telegraph division, division of supplies, publications division, division of accounts, review room, barometry section, library, and aerial exploration section.

For the convenience of the general work of weather forecasting, the country is divided into the following-named forecast districts and centers:

Boston center: The New England States—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

Chicago center: Illinois, Indiana, Michigan, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, South Dakota, North Dakota, and Montana.

Denver center: Colorado, New Mexico, Arizona, Utah, and Wyoming.

San Francisco center: California and Nevada.

Portland (*Oregon*) *center:* Washington, Oregon, and Idaho.

New Orleans center: Louisiana, Texas, Oklahoma, Indian Territory, and Arkansas, and advisory warnings for Mexico.

Washington center: All States not included in the foregoing districts, namely, New York, Pennsylvania, New Jersey, Delaware, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Kentucky, Ohio, and West Virginia.

The official in charge of each forecast center issues the morning

forecasts, the cold-wave, frost, and other warnings (except hurricane and emergency warnings), and the storm warnings for his district, forwarding copies of the same immediately, by telegraph, to Washington.

The forecast official at Washington makes all night forecasts, synopses, and cold-wave warnings for the districts under all centers except San Francisco and Portland. The officials in charge of the latter two centers make night forecasts and warnings for their respective districts.

OFFICIALS AT THE STATIONS.

Each Weather Bureau station has its official in charge, who conducts all the work under instructions from the chief of the Bureau. The number of assistants depends, of course, upon the amount of work to be done. About fifty of the smallest stations have none; at the others, the number varies from one to eight or nine. At centers of forecast districts, such as Washington City, Chicago, and San Francisco, the official in charge has the rank of professor or district forecaster; at storm-warning section centers, as well as at climate and crop section centers, his rank is usually local forecaster or director. In most other cases he has the rank of observer. The observers are of several grades, the classification depending upon length of service, efficiency, industry, fitness, educational qualifications, conduct, etc. Vacancies in the position of observer are filled from the eligible list of those who have passed the required civil-service examination in meteorology and the ordinary English branches and algebra. The age limit of appointees is 18 to 30 years. Nearly all stations have messenger boys. Applicants for the position of messenger are required to take a civil-service examination, and the age limit for appointees is 16 to 20 years. A printer is also included in the regular force at some stations.

DUTIES PERFORMED AT THE STATIONS.

In giving some account of the duties performed at Weather Bureau stations, those common to most of the stations will be mentioned first. During the half hour from 7.30 to 8 a. m. the observer at every station is taking the regular morning observation and preparing a telegraphic report of the meteorological conditions. He observes (from the roof) the condition of the sky; the direction of the wind; the clouds, their amount, kind, and direction of movement; and he scans the sky carefully for the appearance of any unusual phenomena; he measures the precipitation, rain, snow, sleet, or hail; reads the four thermometers—the dry, the wet-bulb, the maximum, and the minimum; records all these observations on the blank form provided for the purpose; and "sets" the self-registering thermometers for another twelve-hour period of registration. He then returns to the office and finishes the observation, which further includes the reading of the barometer and the wind direction and velocity, and also the

"checking" of the readings with those of the self-registering instruments. He then makes the calculations necessary to reduce the barometer reading to sea level, and completes the record of his observations, taking great care to avoid the slightest error in any part of the record. In telegraphing the report a cipher code is in use at all stations. The following sample message and translation will illustrate the utility and economy of the code. It will be seen at a glance that the number of words saved is the difference between the words found in the message and the number of words used in writing the observation out in full.

Regular 8 a. m. report.

Memphis, Target, Lugmark, Geyser, Buforite, Kirby, Tally, Frost, Chamois.

Translation of the cipher words.

Memphis (telegraphic designation of station): Memphis, Tenn.

Target (pressure and temperature): Barometer, 29.92; temperature, 44°.

Lugmark (precipitation for twenty-four hours, all of which fell before 8 p. m.): Precipitation, 0.52 inch.

Geyser (direction of wind, state of weather, and maximum thermometer): Direction of wind, southeast; state of weather, cloudy; maximum temperature, 84°.

Buforite (current wind velocity and minimum temperature): Current wind velocity, 10 miles per hour; minimum temperature, 38°.

Kirby (decrease in pressure during two hours previous to observation, barograph record): Decrease in pressure, 0.10 inch.

Tally (river observation): Water level, 10 feet above zero of gauge, and falling.

Frost: Light frost at station or in vicinity.

Chamois (amount, kind, and direction of cloud, lower): Amount, 8 to 10 tenths; kind, stratus; direction moving from, south.

The average number of cipher words in observation messages is probably about five for each station.

The messages are transmitted over telegraphic "circuits," and are received simultaneously at all places on the same circuit.

A similar course is pursued when the messages are transferred from one circuit to another, so that each telegraphic office sends the report from its own station but once. The reports are "all in" at about 10.30 a. m. As soon as each sheet of the cipher messages is received at a Weather Bureau office the observers rapidly enter the data on geographical charts of the United States. Isobars (lines of equal barometric pressure) and isotherms (lines of equal temperature) are then drawn, to show the distribution of these elements. Auxiliary charts are also drawn, to show the distribution of rainfall and the changes in temperature and pressure during the last 24 hours and the last 12 hours, as indicated by the reports. These duties must be performed rapidly and accurately, and when completed the charts are ready for the forecaster. This stage of the work is reached at practically the same time at every station in the country. About this time the State or general forecast is received from the district center, and

the local forecaster prepares a forecast for his city and vicinity. Then follows the work of distributing the forecasts as rapidly as possible. This is the busiest hour of the day at Weather Bureau offices. The telephone is kept in constant use in answering special inquiries as to the probable condition of weather, wind, or temperature, and the forecasts are then telephoned to the newspaper offices and other offices that have been listed for the information. These duties and the work of printing and wrapping the daily maps, and stamping the forecast cards, so that they may be ready for the first mails, usually require the utmost exertion of the entire office force. When, at this time of the day, a storm warning, a cold-wave warning, a frost warning, or a flood warning is received, the extent to which the "rush" is increased may be imagined, for in these cases bulletins must be hurriedly prepared and telephone messages sent out for the information of the public and the special industries or business interests most concerned.

About 100 of the larger stations issue a daily weather map. This consists of a chart showing the weather conditions at the various stations whose reports have been received, the forecasts of the weather and temperature during the next 36 hours for the city and State in which the station is located or the map displayed, and a summary of the general weather conditions during the past 24 hours. All warnings received from the forecast center before going to press are printed conspicuously on the map. The maps of stations in the agricultural and fruit sections give special prominence to frost warnings; those on the seaboard to storm warnings and the expected direction and force of the wind; those situated on rivers to flood warnings and to forecasts of the rise and fall of the rivers. As a rule, the map can be furnished only for public display for the benefit of a community or for school instruction. Even with these limitations hundreds are issued daily at every station of considerable size. A popular method of disseminating the forecasts is by the forecast cards, which are so well known that no description of them need be given. As the cost involved in their issue is comparatively small, they are much more extensively distributed than the map, and most of the larger stations issue 1,500 to 2,500 of these cards daily for prominent display in public places.

At every station an observation is taken at 8 p. m. This is of the same character as that taken at 8 a. m. No maps are printed in the evening, but the telegraphic reports of observations are sent, received, and charted, as a rule, in the same manner as the morning reports. At climate and crop centers the evening forecasts for the following 48 hours are sent out on forecast cards for the benefit of the agricultural interest, and, through the rural free-delivery routes, reach a large number of farmers the following morning. When storm warnings,

cold-wave warnings, flood warnings, etc., are received at night they receive the most prompt and effective distribution practicable at that time. At many important stations the night observer is required to telephone regularly some of the information contained in the 8 p. m. reports. At Cleveland, Ohio, for example, the two passenger steamship lines for Buffalo and Detroit are informed every evening as to the conditions existing at stations on Lake Erie and on Lake Huron, and the weather that is expected during their night trips. The preparation and delivery of the bulletins containing the reports of the 8 p. m. observations from the different stations, which are published in the newspapers of the following morning, is usually the last duty of the day. Weather Bureau offices are almost invariably closed before midnight, and in some cases an hour or two earlier. Though but two observations are made regularly, special observations are taken and telegraphed when called for by the forecast official at the district center, or by the official at Washington, or when sudden and unexpected local changes occur in pressure, temperature, wind, etc.

The preparation of records forms a large proportion of the station duties. All weather conditions, whether observed or automatically registered by the instruments, are recorded and summarized with great care and detail on blank forms prepared for the purpose.

Among the reports of greatest importance is the daily journal, the purpose of which is to show those characteristics of the weather that are not easily susceptible of tabulation, and to preserve for reference a history of the official events of the day.

In addition to the foregoing, there are many records kept that can not be enumerated here, but which are an essential part of the duties of every station. Further duties, such as those incident to the care of instruments and property of every description, requisitions for necessary supplies, etc., can be mentioned only in a general way. Each station has its share of correspondence with the central office and with the public, the amount depending upon the importance of the station. At centers of climate and crop sections, especially, the amount of correspondence is necessarily large.

INTEREST IN SPECIAL DATA OF THE STATIONS.

Considerable labor is required in the preparation of special data for those who wish to learn what the records say as to the weather conditions on certain dates, or during certain periods, of the past. The engineer, health, and police departments of cities require the records of temperature, wind, and rainfall for various purposes; civil engineers find the rainfall records of great utility in the consideration of plans for sewage systems, waterworks, etc.; railway companies consult them in the consideration of claims brought on account of injury to goods

in transit; contractors engaged in various kinds of construction and repair work frequently find the records valuable in their calculations; city railway companies and the law departments of cities make frequent use of rainfall and snowfall data to aid in the settlement of claims for damages on account of personal injury alleged to have resulted from carelessness of the city or company; invalids and tourists consult the climatological records when contemplating a journey; and the records are often produced in court to aid in the settlement of questions in regard to weather conditions at certain times in the past. The United States Supreme Court has decided that the records of the Weather Bureau are competent evidence of the facts therein stated.

ENCOURAGEMENT OF THE STUDY OF METEOROLOGY.

The Bureau encourages the study of meteorology in the public schools and other educational institutions, and furnishes them the daily weather map free, but, as the map issue is necessarily restricted, it is impracticable to furnish this or other publications of like character free to pupils, or for private use.

WEATHER-BUREAU FLAGS, PENNANTS, AND SIGNALS.

The flags, pennants (figs. 1 and 2), and signals used by the Weather Bureau in forecasting the weather and temperature are explained by the Bureau as follows:

STORM AND HURRICANE WARNINGS.

STORM WARNINGS.—A red flag with a black center indicates that a storm of marked violence is expected. The pennants displayed with the flags indicate the direction of the wind: red, easterly (from northeast to south); white, westerly (from southwest to north). The pennant above the flag indicates that the wind is expected to blow from the northerly quadrants; below, from the southerly quadrants. By night a red light indicates easterly winds, and a white light above a red light, westerly winds.

HURRICANE WARNING.—Two red flags with black centers, displayed one above the other, indicate the expected approach of a tropical hurricane, or one of those extremely severe and dangerous storms which occasionally move across the lakes and northern Atlantic coast. No night hurricane warnings are displayed.

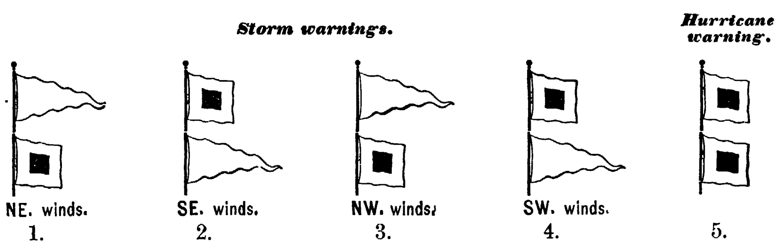

FIG. 1.—Weather Bureau storm and hurricane warnings: 1, red pennant, red flag with black center; 2, red flag with black center, red pennant; 3, white pennant, red flag with black center; 4, red flag with black center, white pennant; 5, red flags with black centers.

WEATHER FLAGS.

The weather flags are five in number and of the forms as follows:

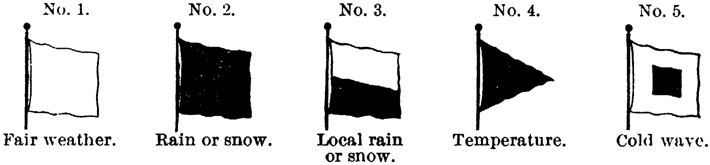

FIG. 2.—Weather Bureau flags used in displaying weather forecasts: No. 1, white; No. 2, blue; No. 3, upper half white, lower half blue; No. 4, black; No. 5, white with black center.

When No. 4 is placed above No. 1, 2, or 3, it indicates warmer; when below, colder; when No. 4 is not displayed the temperature is expected to remain about stationary. During the late spring and early fall the cold-wave flag is also used to indicate anticipated frosts.

WHISTLE SIGNALS.

A warning blast of from fifteen to twenty seconds duration is sounded to attract attention. After this warning the longer blasts (of from four to six seconds duration) refer to weather, and shorter blasts (of from one to three seconds duration) refer to temperature. Those for weather are sounded first.

Blasts.	Indicate.	Blasts.	Indicate.
One long	Fair weather.	One short	Lower temperature.
Two long	Rain or snow.	Two short	Higher temperature.
Three long	Local rain or snow.	Three short	Cold wave.

By repeating each combination a few times, with intervals of ten seconds, liability to error in interpreting the signals may be avoided.

As far as practicable, the forecast messages will be telegraphed at the expense of the Weather Bureau; but, if this is impracticable, they will be furnished at the regular commercial rates and sent "collect." In no case will the forecasts be sent to a second address in any place, except at the expense of the applicant.

Persons desiring to display the flags or sound the whistle signals for the benefit of the public should communicate with the Weather Bureau officials in charge of the climate and crop service of their respective States.[a]

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[a] The central stations of the climate and crop service of the several States are as follows: Montgomery, Ala.; Phoenix, Ariz.; Little Rock, Ark.; San Francisco, Cal; Denver, Colo.; Jacksonville, Fla.; Atlanta, Ga.; Boise, Idaho; Springfield, Ill.; Indianapolis, Ind.; Des Moines, Iowa; Topeka, Kans; Louisville, Ky.; New Orleans, La.; Baltimore, Md. (for Delaware and Maryland); Boston, Mass. (for New England), Lansing, Mich.; Minneapolis, Minn.; Vicksburg, Miss.; Columbia, Mo.; Helena, Mont.; Lincoln, Nebr.; Carson City, Nev.; New Brunswick, N. J.; Santa Fe, N. Mex.; Ithaca, N. Y.; Raleigh, N. C.; Bismarck, N. Dak.; Columbus, Ohio; Oklahoma, Okla. (for Oklahoma and Indian Territory); Portland, Oreg.; Philadelphia, Pa.; Columbia, S. C.; Huron, S. Dak.; Nashville, Tenn.; Galveston, Tex.; Salt Lake City, Utah; Richmond, Va.; Seattle, Wash.; Parkersburg, W. Va.; Milwaukee, Wis.; Cheyenne, Wyo.

THE GROWING OF LONG-STAPLE UPLAND COTTONS.

By Herbert J. Webber,
Physiologist in Charge of Plant-Breeding Laboratory, Bureau of Plant Industry.

INTRODUCTION.

The ordinary cotton grown in the United States has a short staple ranging in length from three-fourths of an inch to 1⅛ inches. Cotton of this grade can be grown without difficulty in many parts of the tropical and semitropical regions of the world. The growing of sorts with longer staple, that is, above 1¼ inches, is attended with some drawbacks, and the regions where these cottons can be produced to advantage are much more limited in extent and number than in the case of short-staple cottons. In the present cotton shortage the demand is for any and all cotton, though this is true at all times to a limited extent. The quantity of long-staple cotton produced is so limited in comparison to that of short staple that a shortage in the long-staple crop does not materially influence the short-staple market. The increasing prosperity of the people is leading to a greater demand for the finer cotton fabrics manufactured from long-staple cotton, and the fear has been expressed that the supply will not long be sufficient to meet the demand.

The growing of long-staple cottons is practically confined to certain portions of Egypt and the United States. Small quantities of long-staple fiber are produced in other parts of the world, but the output is not yet sufficient to influence the market in any way. Considerable interest is being shown in the growing of such cottons in Cuba, Porto Rico, Haiti, and other of the West Indies, but the industry in these islands is still in an experimental stage. Some cotton of fairly long staple comes from Peru and Brazil, but as a whole the fiber is too coarse for fine spinning and is used largely in mixture with wool.

The cottons used for fine spinning are Sea Island, Egyptian, and the so-called long-staple Uplands, and the production of these types has thus far been limited to certain comparatively small areas. The supply of Sea Island cotton is produced in the Coastal Plain region of South Carolina, in central and eastern Georgia, and in northern Florida. The maximum production was reached in 1896–97, when the crop amounted to 103,516 bales. The amount has fallen considerably, and in 1900 only 97,279 bales were produced. Egyptian cotton is as yet grown exclusively in Egypt, the annual output from that country

being now about $1\frac{1}{4}$ million bales. The long-staple Upland cottons, the other group of cottons used for fine spinning and with which we are here principally concerned, are now grown mainly in the alluvial delta[a] region of Mississippi and Louisiana, and to a limited extent in the rich valley lands of the Red River in Texas and Louisiana. Small quantities of long-staple Upland cotton are also produced here and there in all of the other cotton States.

In the statistical returns in this country no distinction is made between long-staple Upland cottons and the ordinary short staple, and it is thus impossible to give a very accurate estimate of the production. An estimate has been made by Mr. Henry G. Kittredge, based upon the production of fine yarn. He states:

> An approximate idea may possibly be had of the amount of long-stapled Upland American cotton used in the United States for fine spinning, as represented by No. 41 and over, by taking the 1900 census figures, which give the consumption of Sea Island and Egyptian cottons at 74,287,566 pounds, and the total production of fine yarn at 77,195,871 pounds. Allowing a waste of 30 per cent on the assumption that these cottons were combed, we have a yarn production from them of 45,001,297 pounds, which, deducted from the total amount of yarn, leaves 32,194,574 pounds of yarn made from the Upland variety. As much of this Upland cotton for the lower numbers in the range from No. 40 and upward is not combed, and can not be so readily assumed as for the numbers for which the Sea Island and imported Egyptian cottons are used, the average waste in manufacture must be less than 30 per cent. I have, therefore, for purposes of calculation, called the percentage of waste on this cotton 20, which would make the 32,194,574 pounds of yarn represent 40,243,217 pounds of raw cotton, or 80,486 bales of 500 pounds each.[b]

There is widespread interest in the growing of long-staple cottons of better quality than the ordinary Uplands, and it is probable that the quantity of long-staple Upland cotton has been considerably increased since 1900, when this estimate was made. It is likely that the production of 1903 has been nearly 105,000 bales, as the cotton crop for that year in the principal long-staple regions, notably in the delta region of Mississippi and Louisiana, was generally considered to be even better than the crop of 1902.

The increasing demand for long-staple cotton is well shown by the rapidly increasing consumption of Egyptian and Sea Island cotton. Quoting again from the article by Mr. Kittredge on "The supply of cotton for fine spinning":

> Great Britain increased her consumption of Egyptian cotton during the twelve years ending with the season of 1901–2 over 38 per cent, and of Sea Island cotton over 9 per cent. For the same period the Continent increased its consumption of

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[a] The so-called delta region of Mississippi and Louisiana, which is commonly known by this name in cotton circles, is not the true delta of the Mississippi River, but is an area bordering the river situated mainly between Memphis, Tenn., and Natchez, Miss. It is a strip of rich alluvial land, extending in some places from 25 to 70 miles back from the river on each side.

[b] Kittredge, Henry G. The Supply of Cotton for Fine Spinning. In Transactions of the New England Cotton Manufacturers' Association, vol. 74, pp. 121–154.

Egyptian cotton nearly 112 per cent, and of Sea Island nearly 200 per cent. During the same time the United States increased its consumption of foreign cotton, chiefly Egyptian, over 680 per cent, and of Sea Island over 150 per cent.

Should this rate of increase continue (and there is every reason to believe that it will), the time will soon come when there will be a decided shortage of long-staple cottons. How this increased demand can be met is therefore a very pertinent question at present.

WHY THE CULTIVATION OF LONG-STAPLE UPLAND COTTONS SHOULD BE EXTENDED.

After a careful study of the cotton industry of the United States the writer has come to the conclusion that the demand for long-staple fine spinning cottons can best be met by increasing the growing of long-staple Upland varieties. This opinion is based on the characters of long-staple Upland varieties, which are probably better adapted to general cultivation in this country than any of the Sea Island or Egyptian kinds, and give with the different varieties now known all ranges of length of staple from $1\frac{1}{4}$ to $1\frac{5}{8}$ inches (Pls. I and II). The fiber of some of the varieties is fine and silky, and can well take the place of Egyptian and of the coarser grades of Sea Island. The fine grades of Sea Island, which are equaled by no other cottons in the world, have only a very limited use, and their production is costly, requiring such a high degree of selection and cultivation that their use will probably never be very greatly extended. Sea Island cotton, moreover, has small bolls, very difficult to pick, and generally gives a very light yield. The successful cultivation of this cotton, as stated above, is at present confined to a comparatively small area. It is probable that this variety could be improved and better adapted to the soil and climate in other parts of the cotton belt, but Upland cotton growers do not like the Sea Island plant, and it would be a difficult task to extend its culture very greatly.

Egyptian cotton (Pl. I, fig. 3) has the disadvantage of having small bolls and of being late in maturing. The bolls open better, however, than those of Sea Island, are more easily picked, and the yield is rather larger. Experiments which have been conducted under the writer's direction indicate that the Egyptian varieties can be successfully grown in various parts of the South, but American planters will always prefer larger bolled sorts, and the introduction of these cottons into general cultivation will be slow. The writer believes, however, that if the demand for Egyptian cotton continues it may be grown extensively and with profit in this country. The greatest obstacle to its rapid introduction is the different form of bale used in shipping the Egyptian staple and the prejudice of manufacturers against taking the staple from a new region not in Egypt. If the American grown staple could be baled like the Egyptian and shipped from Alexandria instead of from

American points, there is little doubt that it would find a ready market. The present adverse conditions must be overcome, however, before the industry can be established in America, and this will probably require a number of years of experimentation.

The long-staple Upland cottons, however, already have an established market and place in the country, and in general suit the ideals of the growers (Pl. III). By proper attention to the methods of cultivation and manuring, together with intelligent selection of the soils on which to grow the crop, the writer believes that their production is capable of almost unlimited extension. With the proper study and encouragement in the growing of these cottons there is certainly no doubt that the normal increase in the demand for long-staple cotton can be met.

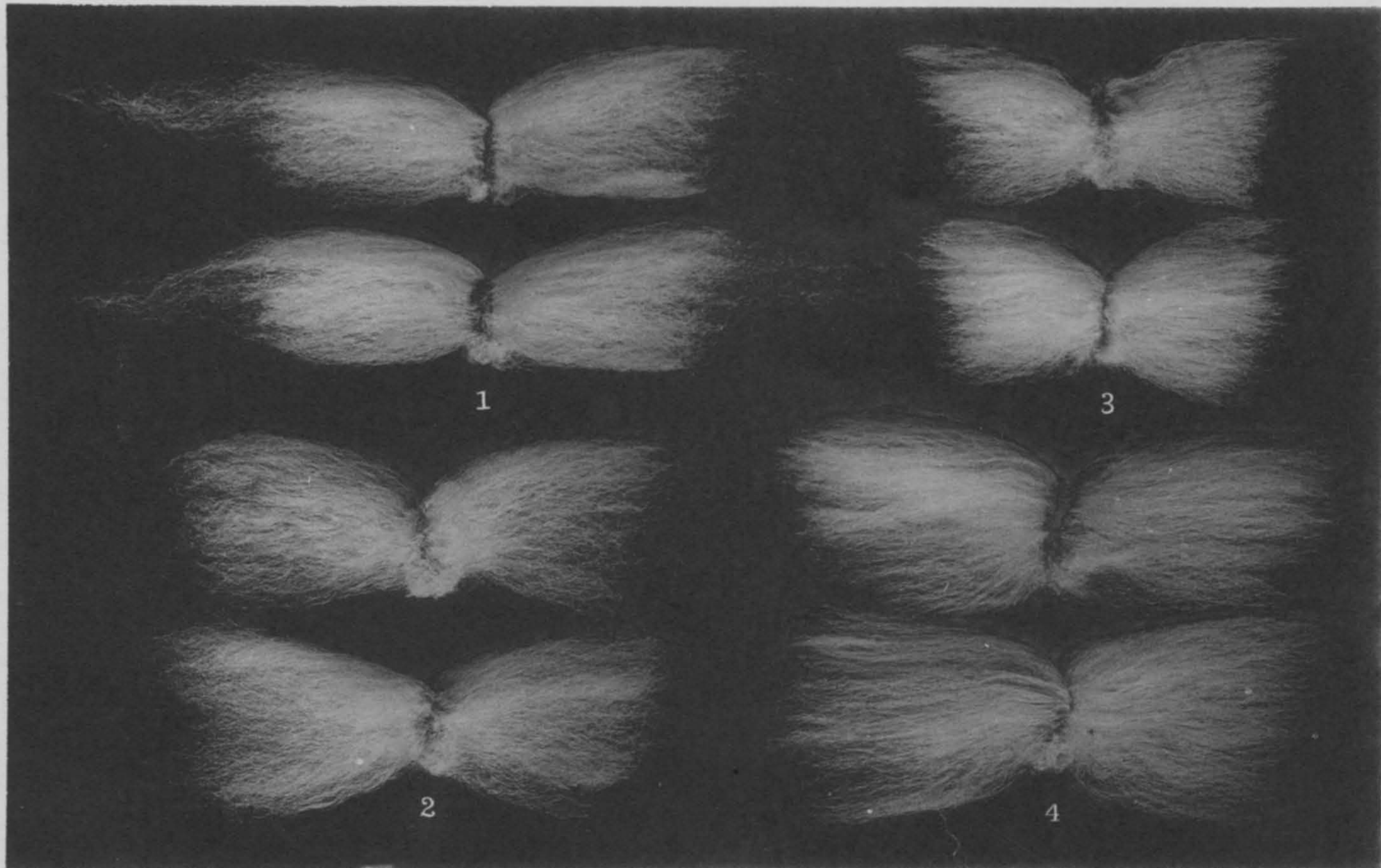
From the standpoint of the general improvement of the industry and of cotton fabrics, this increase is not sufficient. Long-staple cottons produce a better and stronger yarn or thread, and consequently a better wearing and superior quality of cloth. In the improvement of the industry, therefore, cottons with a staple at least 1¼ inches long should gradually supplant the short-staple sorts. In connection with the use of long-staple cottons it is interesting to note that after careful tests the United States Railway Mail Service adopted a heavy duck cloth made from Sea Island cotton as the strongest, lightest, and most durable material for the manufacture of mail bags, and the old leather bags formerly used have been abandoned. If individual fibers are of equal strength, it is easily seen that the longer the fiber the stronger will be the thread that is manufactured from it. When a cotton thread is broken there are always some individual fibers, the ends of which lie near the breaking point, which simply slip apart without breaking. The longer the fiber the fewer there will be of such ends near any one breaking point, and therefore the greater the number of individual fibers that must be actually broken in breaking the thread. If other qualities are equal, therefore, the long-fibered cottons produce a better and stronger yarn and a better fabric.

INTRODUCTION OF LONG-STAPLE UPLAND COTTONS.

The introduction of long-staple Upland cottons has been comparatively recent, but the extension of their use has been so gradual that their history has not been carefully recorded, and even now it is practically impossible to obtain reliable information regarding their origin and spread. The variety Peeler seems to have been the first introduced of what may be termed the long-staple Upland cottons, though it is but slightly longer in staple than the ordinary Upland. According to Prof. S. M. Tracy, this race originated in Warren County, Miss., about 1864. It produces a staple about 1¼ inches in length and has probably been the progenitor of a number of our long-staple Upland

SEEDS WITH LINT ATTACHED, ILLUSTRATING TYPES OF LONG STAPLE COTTON.

1, Ordinary Sea Island. 2, Allen Improved. 3, Imported Mit Afifi (Egyptian). 4, Sunflower.



SEEDS WITH LINT ATTACHED, ILLUSTRATING TYPES OF LONG AND SHORT STAPLE COTTON.

1, Griffin. 2, Southern Hope. 3, Truitt. 4, Hybrid of Sea Island Upland.

sorts. It is interesting to note that the Peeler cotton is still cultivated extensively, although the cotton now known under this name is probably quite different from the original variety. The name has become so well known that it is largely used in trade to refer to any class of cotton the staple of which will range about 1¼ inches in length.

The most marked advance in the development of the long-staple Upland cottons was achieved by the introduction of the Allen Long-Staple, which was originated by Mr. J. B. Allen, of Port Gibson, Miss., about 1879. This variety is said by Mr. Allen to have come from a single fine stalk selected in a field of the so-called "Bohemian" cotton, a variety which he had obtained from Louisiana and the origin of which was unknown. The Bohemian cotton had a fiber about 1¼ inches long and was probably similar to Peeler, if indeed it was not identical with that variety. The original Allen Long-Staple cotton was a compact plant with large white tufted seed and fiber 1½ inches long. It might be supposed from the length of the fiber that the original plant was a hybrid of some Upland cotton with Sea Island, but Mr. Allen believes it to have been simply an individual variation of a pure Upland plant.

In 1892 Mr. Allen originated his Allen Yellow Bloom, which came from a single plant growing in a field planted with Allen Long-Staple. It was the first plant with yellow flowers that he had ever seen in fields of Allen Long-Staple, which has cream-colored flowers, and it was preserved as the progenitor of a new race. The Allen Yellow Bloom had small seeds and rather smaller bolls than Allen Long-Staple, and was very productive. The lint ranged from 1½ to 1⅝ inches in length and constituted from 28 to 29 per cent of the seed cotton. The appearance of a yellow-flowered plant among the Allen Long-Staple plants would indicate that hybridization with Sea Island cotton must have occurred somewhere in the remote ancestry of the race.

The Allen Long-Staple and Allen Yellow Bloom were both found to be rather susceptible to anthracnose, or boll-rot, and in 1894 the Allen Hybrid was introduced, which was not so susceptible to this disease, and was hardier. This variety was believed by the originator, Mr. Allen, to be a hybrid between King and Allen Long-Staple, the original plant having the habit of branching and form of boll of King, but a long staple like Allen Long-Staple.

In 1898 still another long-staple cotton was introduced and distributed by Mr. Allen. This was the Allen Improved (Pl. I, fig. 2), which was supposed to be a hybrid between his Yellow Bloom and Allen Hybrid. It was an improvement in having limbs of medium length and more puffy lint, which is more easily picked.

The above descriptions of the varieties of long-staple cotton originated by Mr. Allen will show how the varieties of long-staple Upland cotton have usually been secured and how imperfectly their origin is

known. So far as the writer can learn from cotton men and from the history of the origin of varieties, the long-staple Upland cottons first came to be generally known about 1880 or 1881. Previous to this time they had not been recognized as of any special value. It was not until Northern buyers began to go South and buy up the staple that the greater value of these cottons came to be known to the growers. In the alluvial delta region of Mississippi and Louisiana, where long-staple cottons first came into prominence, the soil is very rich and does not require artificial fertilization to give good yields. One peculiarity of the fiber grown on such soils is its greater length and fineness as compared with that of the same variety grown on the poorer soils of the hill regions. This feature is one commonly observed by growers. The better and richer the soil the longer and finer the fiber. Soils artificially manured also show the same effect in the quality of the fiber. The staple from the long-staple delta region previous to about 1880 was largely shipped to New Orleans and sold through commission merchants, and did not bring much more to the planter than ordinary cotton. As a matter of fact, the staple was only about $1\frac{1}{8}$ to $1\frac{3}{16}$ inches in length, a slight increase over ordinary Upland cotton, which was probably due mainly to the fertility of the soil rather than to the character of any particular variety or race. The so-called "Benders" cotton, which is well known in the market under this name, is simply any cotton grown in the bends of the Mississippi River, which from its better quality and length of fiber has come to be known to buyers and manufacturers as of special grade. Much of it is doubtless Peeler cotton, but in the majority of cases the planters do not know what variety they are growing.

VARIETIES OF LONG-STAPLE UPLAND COTTON.

The cottons grown in the United States belong to four different groups: (1) Sea Island; (2) Egyptian; (3) Upland, or short staple; and, (4) long-staple Upland. The group of long-staple Uplands, or staple cottons as they are frequently called by growers, includes now a large number of races, some of them quite distinct in their characters. The following list of varieties and strains is not intended to be complete, the object being simply to call the planters' attention to some of the principal races that are now being grown:

ALLEN IMPROVED.—The origin of the Allen long-staple cottons, namely, Allen Long-Staple, Allen Hybrid, Allen Yellow Bloom, and Allen Improved, has already been described. The Allen Improved, the latest variety (Pl. I, fig. 2, and Pl. IV, figs. 1 and 2), was distributed first in 1900, and was included in the seed distribution of the Department of Agriculture in 1902. The variety is recommended because of its productiveness and its long staple. The bolls when ripe open up

FIG. 1.—FIELD OF ALLEN IMPROVED COTTON AT PORT GIBSON, MISS., SHOWING METHOD OF RIDGE CULTURE.

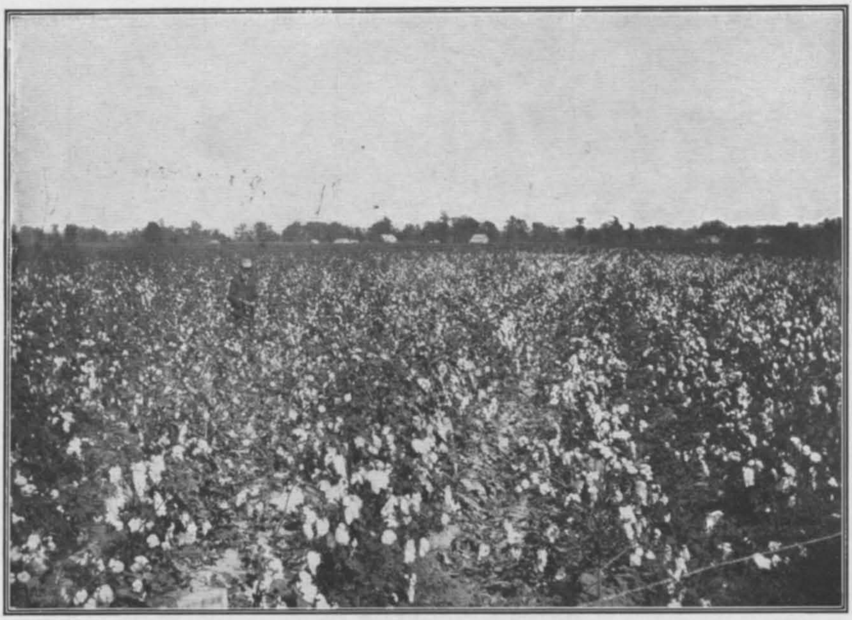


FIG. 2.—FIELD OF WELL-OPEN LONG STAPLE UPLAND COTTON AT YAZOO CITY, MISS.

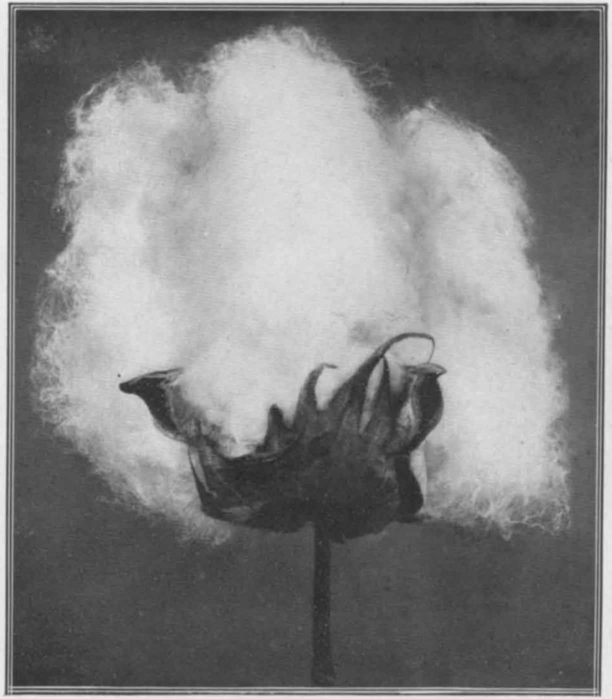


Fig. 1.

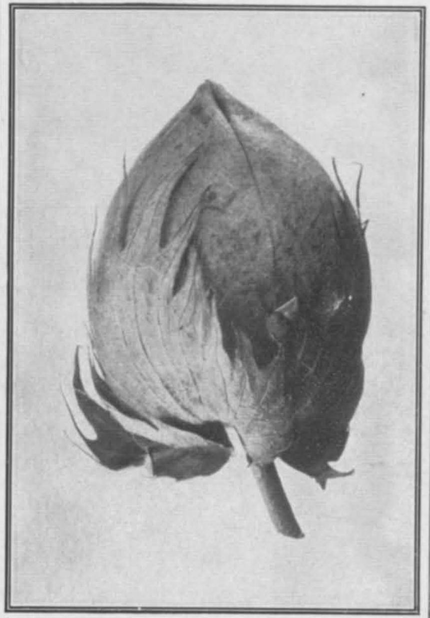


Fig. 2.

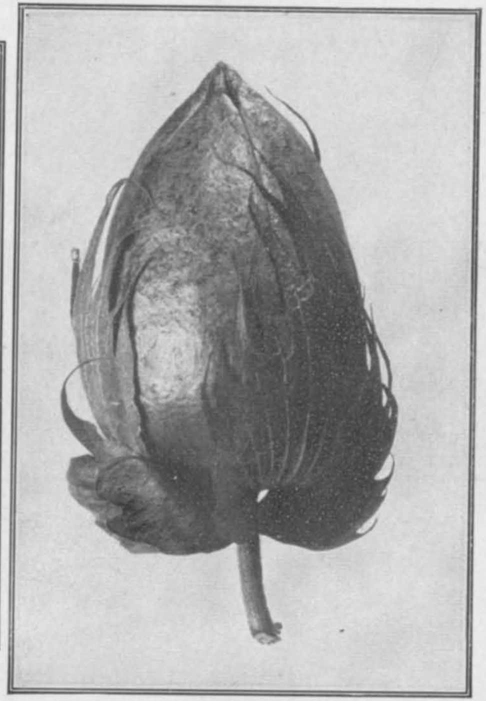


Fig. 3.

MATURE OPEN AND UNOPEN BOLLS OF LONG STAPLE UPLAND COTTON.

[Figs. 1 and 2, Allen Improved; fig. 3, Griffin.]

wide, like ordinary Upland, letting the cotton hang out and making it easy to pick. It is said to pick easier than the Allen Hybrid and to have a stronger fiber. Mr. Allen states that it has stood the weather better for the past three years than any other variety of long staple he has ever planted, not rotting in wet weather, as the Yellow Bloom does. It gives an average yield per acre of about 1,500 pounds of seed cotton and from 300 to 500 pounds of lint. The crop of 1900, Mr. Allen states, sold for 17 cents per pound net; that of 1901 for 15 cents, and that of 1902 for from 16½ to 17 cents. The staple of Allen cotton, according to the statements of spinners, can be handled successfully in warps from 50s to 70s, and in filling, up to 120s or 125s.[a]

Plant 3 to 6 feet high, compact, with two or three long basal limbs and one main central stem. Bolls of Upland type, medium size, slightly pointed, 4 to 5 locked, opening wide. Seeds medium large size, weighing 0.14 to 0.15 gram, gray tufted, 7 to 9 per lock. Lint white, fine, and silky, 1½ to 1⅝ inches long, fairly strong. Per cent of lint, 27. Time of ripening, midseason.

The Allen long-staple cottons are probably now more widely known and grown than any other of the long-staple Upland sorts.

GRIFFIN.—This variety is a long-staple, big-boll Upland cotton (Pl. II, fig. 1, Pl. IV, fig. 3, and Pl. V, fig. 2) produced by John Griffin at Refuge plantation, near Greenville, Washington County, Miss. The first selection was made in the fall of 1867 and the seed planted in the spring of 1868. The variety resulted from a cross of the old "Green Seed" cotton with Sea Island, the cross being made to give a tendency to the Green Seed to produce a longer and finer fiber. The hybrid was from 12 to 16 feet high and very unproductive. It was recrossed five years in succession with pollen of the constantly improved Green Seed. This resulted in reducing the stalk to within a few inches of the length of that of Green Seed, giving it a larger boll, and making it nearly as prolific. Every successive crossing was made on stalks which least resembled the Sea Island in form and most nearly approximated the Sea Island in character of lint. After about ten years of selection some seed were distributed among friends in the vicinity of Greenville, and a few bushels were sold. The variety, however, was never very generally distributed until it was included in the seed distribution of the Department of Agriculture in 1902.

Griffin cotton is without question one of the best long-staple Upland sorts that have ever been produced. Unfortunately, the lint is not very uniform in length, and is inclined to be low in strength. In size of boll, ease of picking, and productiveness, the variety is very good. A peculiar feature of Griffin cotton is its tendency to produce a few very long fibers. Frequently a group of several dozen fibers will reach a length of 2½ or 3 inches, while the average length is only about 1⅜ to 1½ inches.

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[a] Standard sizes of yarn, similar to the familiar sizes of sewing thread.

The average yield per acre at Mr. Griffin's plantation, on Mississippi bottom land not having been cultivated more than twenty years, is about 400 pounds of lint cotton. On fresh land of this sort it yields about 500 pounds of lint cotton per acre. The proportion of lint to seed cotton, Mr. Griffin states, is about 28 per cent. Professor Tracy, at the Mississippi experiment station, gave the percentage as 28 to 29. Professor Duggar, at the Alabama experiment station, obtained 29.2 per cent from the crop grown at Auburn, Ala. The crop produced at Columbia, S. C., the past season gave about 29 per cent.

As an indication of the market value of this cotton, Mr. Griffin gives results of sales as follows: When short-staple was selling at 5 cents per pound Griffin sold at 8¾ cents. In 1900, when short-staple cotton was quoted at between 8 and 9 cents, Griffin sold for 15 cents. In 1901 it sold for 12 cents, against 8 cents for short-staple of the same grade.

Plant 3 to 5 feet high, vigorous and prolific, with main central stem and several large spreading limbs below; foliage pale green. Bolls medium large, ovate, blunt-pointed, 4 to 5 locked, opening well. Seeds of medium size, weighing about 0.12 to 0.13 gram, gray tufted, 7 to 10 per lock. Lint white, fine, and silky, rather variable in length, ranging from 1⅜ to 1½ inches; per cent of lint, about 28 to 29. Season medium.

Cook.—Originated by W. A. Cook, of Newman, Miss., from a single select stalk found in a field of ordinary cotton in 1884. The plant is prolific and a vigorous grower. The bolls, which open well and are easy to pick, are large and long; season of maturing, medium late; lint 27 to 28 per cent, with length of about 1⅜ inches; strength, medium. Cook is recognized as one of the best of the long-staple Upland varieties and is cultivated extensively in the delta region. In trials in South Carolina the results were indifferent, but tests should be repeated before condemning the variety for that section. A strain of this variety grown near Yazoo City, Miss., examined by the writer in the summer of 1903, gave uniformly the strongest fiber of any long-staple cotton tested in that region.

Commander.—This variety was originated by R. C. Commander, of Florence, S. C., from seed obtained in Virginia. The plant is similar to Peterkin in shape. The bolls are ovate, medium to small in size, but open well; lint, 1⅜ to 1½ inches in length. The Commander cotton has come to be well known in the vicinity of Florence, and is said to be thoroughly adapted to growth in that section.

Moon.—Originated by J. Moon, of Peytonville, Ark., about 1875, being a selection from a single plant producing a specially fine staple. Bolls, large, oval, medium in time of ripening; lint, 31 to 33 per cent; staple, 1¼ to 1⅜ inches; medium in time of maturity. The lint of this variety is said to be very strong, but the writer has had no opportunity to confirm this statement. The variety is still grown in parts of Arkansas and Louisiana.

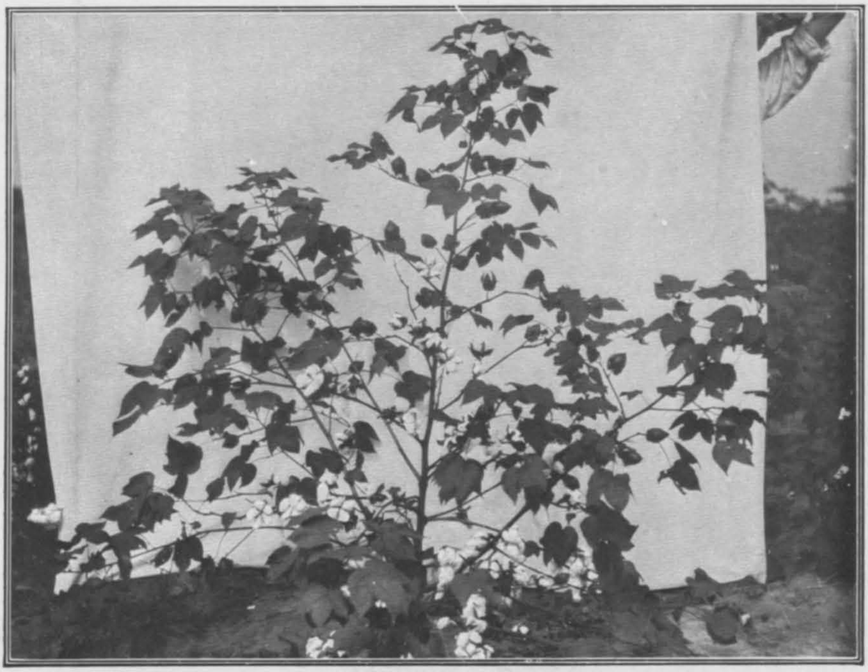


FIG. 1.—PLANT OF SUNFLOWER COTTON, GROWN AT COLUMBIA, S. C.

FIG. 2.—PLANT OF GRIFFIN COTTON, GROWN AT COLUMBIA, S. C.

PEELER.—This was probably the first of the long-staple Upland varieties to be introduced, and was originated in Warren County, Miss., about 1864. Bolls large, opening well and easy to pick; lint, 30 to 32 per cent; staple, 1¼ inches long; season of maturing, late. This is probably the most widely grown of the long-staple Upland cottons, being in general cultivation throughout the delta region of Mississippi and Louisiana. It is so well known that any cotton of this length is not uncommonly referred to in the market as Peeler cotton. It is stated by manufacturers that Peeler cotton can be spun in warps from 40s to 50s, and in filling from 50s to 70s.

SOUTHERN HOPE.—According to Prof. S. M. Tracy, this variety was originated many years ago by Col. F. Robieu, of Louisiana, from seed said to have come from Peru. It produces a staple averaging about 1¼ inches in length and yields from 30 to 32 per cent of lint. It matures late, but is ordinarily early enough to give good results in the delta region, where it is widely grown. It is considered one of the best varieties for general culture in that section.

SUNFLOWER.—This variety (Pl. I, fig. 4, and Pl. V, fig. 1) is of unknown parentage, being the offspring of seeds shipped to an oil mill in Yazoo City, Miss., in 1900, which were purchased for planting by Marx Schaefer. Selections of seed from the best-shaped and most prolific plants were made that season, and the same method of selection has been followed for each succeeding crop, with the result of making the plants more uniform in shape and more prolific. The yield has been from 300 to 500 pounds of lint per acre, fully equal to the yields of short-staple varieties grown during the same season on the same plantation. The crops sold in Yazoo City during the last three years have brought 14½ to 15½ cents per pound, and no other cottons sold in the same market have brought a higher price.

Plant vigorous and productive. Bolls medium size, ovate, blunt-pointed, opening well, but not dropping the seed cotton. Lint fine, 1⅜ to 1½ inches in length; 30 to 31 per cent of the seed cotton. Season early.

The writer grew a small plat of Sunflower cotton during the season of 1903 at Columbia, S. C., in comparison with all of the well-known varieties of long-staple Uplands. It is certainly a distinct variety from any known to him, being about ten days earlier than any long-staple Upland variety tested in comparison with it. Its earliness and productiveness indicate that it will be found a good variety for general culture.

MISCELLANEOUS.—Aside from the varieties or races above described there are a number of other less known sorts which may prove valuable in certain sections. Among these may be mentioned the following: Bailey, Brag Long-Staple, Cobweb, Cochran, Colthorp Pride, Ethridge,

Eureka, Ferrell Prolific, Jones Long-Staple, Maxey, Ozier or Ozier Silk, Six Oaks, Willis, Wonderful, Black Rattler, Toale, Howle, etc.[a]

IMPROVEMENT OF VARIETIES.

Considering the short period that has elapsed since the introduction of the first of the long-staple Upland cottons, great advance has been made in the general improvement of the varieties. Much still remains to be done, however, to adapt them better to general culture. The chief objection to these cottons, as a class, is their light yield. None of them gives more than 28 to 32 per cent of lint, and as an average the longer-stapled forms seldom give more than 27 or 28 per cent of lint. Thus, while the yield of seed cotton is frequently as great as in the case of short-staple sorts, the lint yield is ordinarily considerably lower. A yield of a bale per acre is sometimes made of varieties like Allen and Sunflower, but the same fields under the same conditions would probably have given a somewhat larger yield of some of the short-staple sorts. There would seem to be no inherent reason why these long-staple Uplands can not be made as productive as the ordinary short staple. Some of them have the same form of plant, leaf, and boll as ordinary Upland cottons, and the production of long fiber, so far as we can judge, requires no more actual plant food per pound of fiber than the production of a short staple. The low percentage of lint and consequent low yield must be improved until as much lint per acre of $1\frac{3}{8}$ or $1\frac{1}{2}$ inch fiber can be grown as of the short staple. For several years the writer has been conducting experiments in the production of long-stapled, big-bolled Uplands by hybridizing varieties of the ordinary short-staple sorts with Sea Island. The necessity for securing sorts giving a larger percentage of lint per weight of seed cotton has been constantly kept in mind, and very many individual plants have been found having much better covered seeds and yielding a larger percentage of lint than any of the long-stapled Uplands now grown. Two seeds from one of these hybrids are shown in Pl. II, fig. 4. None of these hybrids has as yet been bred into a fixed race, but it is believed that this can be accomplished, and careful experiments are being conducted with this end in view.

Some of the shorter stapled races of long-staple Uplands now give a fair percentage of lint per seed, and nearly equal ordinary short-staple sorts in productiveness. Peeler, which has fiber from $1\frac{1}{8}$ to $1\frac{1}{4}$ inches long, gives from 30 to 32 per cent of lint, and Southern Hope, which has fiber averaging about $1\frac{1}{4}$ inches in length, usually gives from 30 to 32 per cent. Even the longest stapled of these sorts are but little below ordinary short-staple cotton in productiveness, and with the greater

[a] For descriptions of most of these varieties, see Prof. S. M. Tracy's "Cultivated varieties of cottons," in The Cotton Plant, Bulletin 33, Office of Experiment Stations, U. S. Department of Agriculture.

value of the lint their growth is probably rather more remunerative under ordinary conditions where they can be grown to advantage.

The fiber of the long-staple Upland races is also rather low in strength, and this is another feature that must be improved before they will be perfectly satisfactory. Different individual plants vary greatly in strength of lint, and there can be no doubt that stronger fibered varieties can be produced. Some varieties under certain conditions will produce strong fiber and under other conditions weak fiber. It is probable that the nature or composition of the soil and of the fertilizer used has much to do with this character, but the knowledge now possessed is not sufficient to allow of definite statements. It is a general belief that staple produced by plants grown on light, sterile soils is weaker than that produced by plants grown on rich soils. The correctness of this statement is doubtful, however, as the writer has found sterile fields producing strong fiber, while the rich delta lands of Mississippi, planted with the same variety, give a fiber generally low in strength. The writer is aware that strength in cotton fiber is relative. What is strong for a long-staple Upland would be weak indeed for a Sea Island or Egyptian. Many times, in discussions with cotton buyers regarding the strength of long-staple Upland cottons, he has found that their knowledge is based on a comparison of locally grown sorts only. There can be no question that as a group the long-staple Uplands are weak in fiber, and that varieties with uniformly stronger fiber are much to be desired.

Other features to be desired in improved varieties are uniformity in length of staple, larger bolls, and earlier maturity. In almost all of the long-staple Upland sorts the lint is rather shorter on the pointed than on the rounded end of the seed, and when the staple reaches 1½ inches in length it is important that it be uniform in length. In some sorts, such as Griffin, some of the fibers are very long, reaching 2½ and 3 inches, while the majority are only 1⅝ inches (Pl. II, fig. 1). This would cause waste in manufacturing, and is thus an undesirable character. All of the varieties of these cottons now known, except Griffin, have comparatively small bolls, and large-bolled varieties are greatly in demand among American growers because of the ease in picking, etc. Most of the varieties are late, and early maturity in all cotton is of great importance. The Sunflower is nearly ten days earlier than any other long-staple cotton known to the writer, but still earlier varieties are much to be desired. The improvements considered desirable are discussed here to call the attention of growers to them, with the hope that varieties showing some of these characters may shortly be secured.

THE SELECTION OF SEED.

It is a well-known fact that races of cotton become mixed and impure unless special care is taken to prevent crossing with other sorts. If, therefore, fields of long-staple Upland cotton are growing in the

vicinity of fields of ordinary short-staple Upland cotton, the seed for planting should be taken at some distance from any short-staple plants. It is desirable to locate the seed field off by itself, half a mile or more from any other cotton. Besides precautions to keep the seed pure, it is also very desirable that some careful method of seed selection be regularly followed. It is desirable to keep the variety up to its full productiveness and better adapt it to local conditions, and this may be accomplished by simple and inexpensive methods of seed selection. The following is a simple method, and one which is easy of application:

Choose one or more careful pickers that remain on the plantation continuously from year to year and train them to recognize the best plants, that is, those most productive, earliest in maturing, and having the largest, best-formed, and most numerous bolls. It is also advisable, where time permits, to have these special pickers learn to pull the lint from the seed cotton and test it as to length, to see that this quality is maintained up to the maximum. Each year, before the first and second general pickings, have these skilled pickers go over the field and pick the cotton from the best plants only. These pickers should of course be paid by the day, and not according to the quantity picked. Sufficient seed cotton should be thus carefully picked to furnish, when ginned, the amount of seed necessary for planting the next year. To avoid mixing, preserve such seed separately, and gin it on a carefully cleaned gin.

There is some difference of opinion as to the best cotton to pick for seed. Most planters claim that it is not best to take the cotton either from the first bolls that open, as these are liable to be small and imperfectly formed, or from those that open late in the season. Probably the first and second pickings furnish the most desirable seed, if care is used not to pick from any of the small or poorly formed bolls. Owing to the danger of picking the cotton from small and imperfectly formed bolls, it is frequently recommended that the seed be saved from the second and third pickings, where four pickings are made. More exact data, showing more definitely the effect of selecting seed from different pickings, are very much desired.

Where growers are in a position to do so, they should adopt a more careful method of selection than that described above. More complete methods will be found fully described in an article by the writer on "The improvement of cotton by seed selection" in the Yearbook of the Department for 1902.

METHODS OF CULTIVATION.

The methods of cultivation used with long-staple Upland cottons are the same as those used in cultivating ordinary cottons, and need not be described in detail. These methods should vary according to the locality and soil conditions. In the delta region of Mississippi and Louisiana,

where the long-staple Upland cottons are extensively grown, a certain method of culture is quite generally used, but under other conditions this method would probably not prove satisfactory. In regions where they have not been grown to any extent, the best direction for their cultivation and manuring that can be given is simply to follow the practice that has been found to give the most satisfactory results with ordinary cotton. In the delta region, where the soil is very rich, the rows are placed from 4½ to 6 feet apart and the plants from 15 to 20 inches apart in the rows. In many cases the rows are placed much nearer together, some fields being planted at about 3½ and 4 feet. In this region the rows are planted on rather high beds, this being necessitated by the lowness of the soil, to secure drainage. (See Pl. III, fig. 1.) In South Carolina and Georgia the writer has seen excellent results with comparatively level culture. In the delta region the land for cotton, when following corn and cowpeas, is usually plowed before Christmas, no fertilizer being used. The plow is usually run about 3 inches deep. Shallow plowing is the general practice in this region. "The more shallow the cultivation, the better the crop," is a statement which several of the best growers emphasized in talking with the writer. It is not probable, however, that this practice would prove at all satisfactory in other regions. After the first plowing the land lies idle until about the middle of March, when it is rebedded ready for planting. The average date when planting begins in the delta section is about April 10.

If the land intended for cotton was planted in cotton the preceding year nothing is done toward the preparation of the soil until the last of January or in February, when the land is rebedded, the soil being turned into the old water furrow, and the beds made alternate with those of the preceding year. If the stalks of the preceding crop are difficult to turn under, they are knocked down and broken up by running a cornstalk cutter over the field. In the delta region described, cotton is ordinarily planted by some single-row planter. Corn planters are sometimes used with cottons that have smooth black seeds, but their use is seldom possible, as none of the varieties has uniformly smooth seeds, and ordinarily a force-feed planter is necessary. Frequent and shallow cultivation has in general been found to give the best results in this section. A cultivation is given about every ten days, the aim being to keep the surface throughout stirred up and loose, so as to form a sort of mulch for the moister soils below and to keep the weeds down. The cultivation should be continued till the cotton becomes too large to admit of passing between the rows. The principal tools used for cultivation in the delta region are the sweep and some cultivator with narrow 2½-inch-wide shovels. If the fields get too grassy and weedy, as sometimes occurs, it may be necessary to turn the weeds under with a plow. The general practice is to hoe about four times during the season.

Planters ordinarily do not hoe as many times as they cultivate. The crop is generally laid by, all cultivation ceasing, about the 10th to the 15th of July. Sometimes the cultivation is continued until August if this is found necessary.

PICKING, GINNING, AND BALING.

In the ginning and baling of long-staple Upland cotton it is necessary to bear in mind at every point that a fine product is being handled, and that great care is necessary if the greatest profit is to be realized. This is particularly the case in connection with picking, preserving, ginning, and baling. Greater care should be exercised in the picking to avoid getting the fiber mixed with fragments of leaves, bolls, etc. Fiber from immature and weather-stained bolls should also be discarded. Pickers familiar with ordinary cotton methods are likely to be too careless in their endeavor to gather large quantities and thereby increase their wages. In fine grades of long-staple Upland cotton it will probably also be found desirable to spread the seed cotton on a platform to dry in the sun for a few hours before storing it. This practice is regularly followed by Sea Island cotton growers, but so far as the writer is informed, has not been adopted by growers of the long-staple Upland, and it must be conceded that fair results are obtained where no drying is practiced. It is of course necessary after heavy dews and rains that the seed cotton be thoroughly dried before storing it in the seed house.

The difficulty of properly ginning long-staple Upland cottons has been considered an impediment to their general cultivation. It is generally recognized that long-staple Sea Island sorts require to be ginned on a roller gin, as the saw gins tear and break the fiber to such an extent as greatly to reduce its value. It is also very commonly supposed that the long-staple Upland cottons require to be ginned on a roller gin, and this understanding has prevented many from attempting to grow these cottons, as roller gins are ordinarily accessible only to growers in regions where Sea Island cotton is cultivated. Experience has shown, however, that long-staple Upland cottons can be ginned on ordinary saw gins if care is used in the process. Before ginning these cottons the gin saws should be sharpened square across the teeth and then dulled somewhat by use in ginning ordinary short staples. It is also important to run the gin at a lower rate of speed than in ginning short-staple cottons. All through the delta region, where the long-staple Upland cottons are grown, they are uniformly ginned on saw gins, the saws being run usually at a speed of about 300 revolutions per minute. The finest stand of roller gins which the writer has ever seen was installed by a company at Vicksburg, Miss., especially to gin cottons of this sort. There can be no doubt that the cotton ginned on roller gins is much superior to the saw-ginned product,

yet this fine stand of roller gins remains idle and unused. Roller ginning is so much slower and more costly that growers prefer to use saw gins. Much of the long-staple cotton, however, is very poorly ginned, being torn and cut up and full of "naps," so that its value is greatly reduced. It is a question whether it would not be better to use roller gins in preparing the longest fibered sorts, but they are not now used. The fact that no roller gin is accessible on which to gin the product need not deter anyone from cultivating these cottons. When the precautions above given are carefully observed the long-staple Upland cottons may be satisfactorily ginned on any ordinary saw gin if the seed cotton is well matured and preserved thoroughly dry and in good condition.

Long-staple Upland cotton is baled exactly the same as short-staple cotton, that is, in the ordinary square gin bales or in round bales. By far the larger part of the crop is put up in square bales, rather more care than usual being taken to cover the entire surface of the bale with closely woven burlap. The cotton being more valuable than ordinary cotton, more care should be exercised to protect it from becoming stained and damaged in shipment. The round bale is particularly well adapted for long-staple cottons, and the writer would urge the use of this form of bale wherever possible. The process of recompressing the square bale is known to break and seriously injure long-fibered cottons by the sudden thrust under great pressure, and is never used with the fine long-staple Sea Island cottons. By the use of the round bale this source of injury is avoided and the fiber is put up in a neat package, specially adapted for shipment by rail or steamer.

MARKETING.

It is also important that growers of long-staple Upland cottons give special attention to the marketing of the product. The writer in the season of 1902 saw several bales of long-staple Upland cotton sold to a buyer at a small interior town in South Carolina for 10 cents per pound which were certainly equal to bales of similar cotton which he saw sold in the New Orleans market the week following at 15 cents per pound, when ordinary cotton was selling at $8\frac{1}{4}$ cents. Many of the failures with long-staple Upland cotton have been due to lack of experience on the part of the grower in the matter of marketing. Many buyers take advantage of the growers' ignorance and purchase cotton for 10 cents per pound that is worth 15 cents and realize the difference themselves. In many localities where long-staple cotton is not generally grown, the buyers are not informed as to the value of the different grades and necessarily protect themselves by giving the minimum price. In $1\frac{1}{4}$-inch staple, for instance, scant quarter, quarter, and full quarter give variations in value which are important to the grower.

Every eighth or sixteenth of an inch added to the length of the fiber increases the value.

The following prices, obtained for long-staple cottons marketed at Yazoo City, Miss., the past autumn, indicate something of the range of value of different lengths of staple:

Prices of cotton of different lengths of staple.

Name of cotton.	Grade length, full.	Date sold.	Price per pound.
	Inches.		*Cents.*
Sunflower	$1\frac{3}{8}$ to $1\frac{1}{2}$	October 1	$15\frac{1}{4}$
Do	$1\frac{3}{8}$ to $1\frac{1}{2}$	October 8	15
Allen	$1\frac{3}{8}$ to $1\frac{1}{2}$	October 8	15
Southern Hope	$1\frac{1}{4}$	September 30	$12\frac{3}{4}$
Chitister	$1\frac{1}{4}$	September 30	$12\frac{3}{4}$
Do	$1\frac{1}{4}$	September 30	$13\frac{1}{2}$

Ordinary cotton in the same market sold October 8 at about 9 cents, and this was about the average price from September 30 to October 8.

Until buyers inform themselves on the value of long-staple cotton and pay reasonable prices it will have to be consigned to general long-staple markets, such as New Orleans, Vicksburg, Savannah, or Charleston, or to some of the large New England markets, such as Providence or Boston. An increasing number of Southern mills, particularly in Georgia and South Carolina, are coming to use long-staple cotton purchased mainly in Mississippi and Louisiana. In the immediate vicinity of such mills a ready home market should be obtained for the long-staple product. The length of staple desired by such mills should be ascertained and varieties selected for cultivation which ordinarily produce staple of this length.

Long-staple Upland cottons have been successfully grown in many sections in South Carolina, Georgia, Alabama, and Texas not now recognized as in the regions producing these cottons. There seems to be no reason why these cottons can not be grown on any good, rich cotton land properly manured and cultivated. In any good cotton region where mills are located which use long staple, the growing of this cotton in the immediate vicinity should be thoroughly tested and encouraged. By a proper selection of varieties the writer believes that staple of almost any length desired, up to $1\frac{1}{2}$ inches, can be produced on good soils in any good cotton region, and the cooperation of mill owners and planters in the production of the staple desired should result in benefit to both.

THE UNITED STATES DEPARTMENT OF AGRICULTURE AND SILK CULTURE.

By L. O. Howard, Ph. D.,
Entomologist.

EARLY SILK CULTURE IN THE UNITED STATES.

Silk culture was carried on to some extent by the early colonists of Virginia, South Carolina, and Georgia. Some reeling was done upon hand reels, and both reeled silk and cocoons were exported to Europe. Silk culture is said to have been introduced into New England about the year 1660 by a Mr. Aspinwall, who had nurseries of the mulberry at New Haven and on Long Island. Some trees were transplanted in Mansfield, Conn., and Mr. Aspinwall furnished the inhabitants of that town with the eggs of the silkworm. Reverend Doctor Styles, an early president of Yale College, aided Mr. Aspinwall in his efforts to introduce the culture in Connecticut. The progress of the work was arrested by the war of the Revolution. Silk culture was also begun in Pennsylvania and New Jersey in 1771, and here also was interrupted by the Revolutionary War, but it was partly revived after the treaty of peace. A few people retained their interest in the industry during the early part of the nineteenth century, and in the late twenties a resolution was introduced into the House of Representatives directing the compilation of a manual on the culture of silk. House Document No. 226 of the Twentieth Congress, first session (1828), is a treatise on the rearing of silkworms, by Mr. De Hazzi, of Munich, translated from the German apparently by Mr. James Mease, of Washington, D. C. This seems to have been the first Congressional action favoring silk culture. In 1831 the house of representatives of the State of Massachusetts investigated the possibility of silk culture in that Commonwealth, and by resolution of February 24, 1831, the governor was requested to have compiled and printed "a concise manual to contain the best information respecting the growth of the mulberry tree, with suitable directions for the culture of silk," and directing that the manual be distributed in suitable numbers in the city of Boston and in every town of the Commonwealth, the expense not to exceed $600. Later an additional number of copies was purchased, and the Congress of the United States passed a resolution to purchase 2,000 copies for distribution by members. The result was a manual by J. H. Cobb, published in Boston in 1831 (new edition, 1833).

THE MORUS MULTICAULIS CRAZE.

Following the publication of the book mentioned there began a determined effort to establish silk culture on a firm basis in the United States. It was estimated that 4 tons of silk cocoons were produced in 1833 in the county of Windham, Conn. Individuals in Massachusetts were said to have cultivated it with success for thirty years. This interest in silk culture soon passed beyond bounds, and there originated what is known as the *Morus multicaulis* craze. Anticipating a most profitable investment, if not speedy riches, thousands of individuals purchased mulberry plants of the Multicaulis species and planted large areas of valuable land. The investments far exceeded possible returns; heavy frosts destroyed the plantations of trees, and in the course of a few years the many failures and great disappointments caused so complete a revulsion of feeling that not only was silk culture practically abandoned all through the States, but the very name became a byword.

THE SILK INDUSTRY IN CALIFORNIA.

Ten years or more after the discovery of gold in California had attracted many thousands of people to that State, and at a time when its extraordinary agricultural prospects were first beginning to be exploited, the silk industry began to raise its head there. Near San Jose, in 1861, a Frenchman named L. Prevost, having begun the propagation of the mulberry, succeeded in raising excellent cocoons. In the transactions of the State Agricultural Society for 1864–65, Mr. Prevost published a short article on silk culture in California, in which he showed that his first plantings were made in 1853 or 1854, and that he had induced two ladies, named A. Packard and E. Goux, of Santa Barbara, to start a plantation of 3,000 trees, with the result that in 1864 they raised 5 pounds of silkworm eggs. Plantations had also been made in the San Joaquin Valley, and 50,000 trees had been set out near central Utah. The profits anticipated by Mr. Prevost were largely in the sale of eggs, and he stated that he had received orders from Italy for 100 pounds and from Mexico for 500 ounces.

In 1865 the legislature of California offered a bounty for the production of mulberry trees and silk cocoons, and in the transactions of the State Agricultural Society for 1866–67 it was stated that the liberal action of the legislature and the success which attended the production of mulberry trees and silk cocoons had induced the starting of a very extensive factory at San Jose. The statement was made that the necessary machinery had been purchased and imported.

In the report of the U. S. Department of Agriculture for 1878, Prof. E. W. Hilgard showed that in spite of its favorable beginning, silk culture was almost extinct in California in 1877. He called the interest

which existed in the sixties a mania, stating that it raged with unabated fury for several years, inflicting severe losses upon those who indulged in the popular delusion that the silkworm would thrive in the State without any precautions as to shelter and such intelligent care as could be given only by those versed in its treatment. "Some of the airy sheds that were supposed to be an adequate protection against the comparatively slight changes of temperature are still extant as monuments of that flush period when mulberry trees were thought to be the only nursery stock worth having."

After the subsidence of the craze silk culture was kept up on a small scale at San Francisco by Mr. J. Neumann for many years.

EFFORTS TO STIMULATE THE INDUSTRY.

When, in June, 1878, Prof. C. V. Riley was appointed Entomologist of the U. S. Department of Agriculture, he brought with him from Missouri a strong interest in silk culture and a conviction that this industry could be established in the United States. During his first year in office he published a manual of instructions in the culture of the silkworm. In the same year at the St. Louis meeting of the American Association for the Advancement of Science, under the title "A new source of wealth to the United States," he presented a paper, largely statistical, with tables of exports and imports of raw and manufactured silks for the previous half century, bringing out the steady growth of the manufacturing industry of the country. He showed that the failure of the attempts in California was largely due to the extravagant statements and excessive enthusiasm, verging on fanaticism, which characterized all of the writings of L. Prevost. He said: "Had he been as prone to report failure as he was to magnify success there would not have been a reactive depression which was as unnatural as over-enthusiasm." He stated that Monsieur Prevost's little work, "California silk grower's manual," was better calculated to produce another Multicaulis craze than to healthily stimulate the silk industry. Its extravagant statements and immoderate pictures earned for its author the name *blagueur*, which had been applied to him in France. Professor Riley showed that M. E. V. Boissière, a silk grower in Kansas, had established an important silk colony, whose efforts were intelligent, but that the industry lagged there for the reason that it was found less profitable than stock raising and general farming. It was further shown that several bales of cocoons had been shipped by E. Fasnach from Raleigh, N. C., to Marseilles, for \$3 freight per 100 pounds. The bales, 6 by 5 feet in size, averaged about 40 pounds of stifled cocoons, and brought, in 1876, \$2.50 per pound. Brokers in New York in this period offered \$1.75 to \$2 per pound for cocoons. This was the period of silk-culture depression in France, owing to the

ravages of the silkworm disease known as pébrine. Cocoons commanded a very high price, and silk raisers in America—notably Mr. L. S. Crozier, then of Kansas and afterward of Louisiana—found it more profitable to raise eggs for export than to raise cocoons. Professor Riley also showed that the experiments of the past, and those which he had been carrying on, established the fact that the climate of the larger part of the United States is admirably adapted to silk culture, and that experience had shown that in the past the culture had failed largely because of the want of a market. The great need was the establishment of filatures or reeling factories. All attempts to stimulate the industry unduly are hurtful. He urged that each State should not only encourage the culture of silk, but offer a bounty of say 50 cents or $1 per pound for the choked cocoons, and $1 or $1.50 per pound for reeled silk. He further showed that the native osage orange makes excellent silkworm food.

SILK CULTURE BY THE DEPARTMENT OF AGRICULTURE.

Holding the above views, it was quite natural that Professor Riley should immediately endeavor to interest the head of the Department of Agriculture in the subject of silk culture, and through him to interest Congress; but in the spring of 1879 he severed his connection with the Department and was succeeded by Prof. J. H. Comstock, who held the office for two years. In 1879 the Department made a number of experiments on the feeding of silkworms, and a few eggs were sent out to correspondents. In 1880 Commissioner Le Duc urged in his report to the President that the attention of Congress be called to the importance of affording Government aid to the industry, which should last at least long enough to educate the people to the work. He cited England's bounties for useful inventions and almost lavish expenditures to build up such industries as tea, cotton, and sugar in her colonies, as well as the aid given by France and Germany to the sugar-beet and other industries. During that year the Department ordered silkworm eggs from Japan, but the supply arrived late in the winter, and owing to the heat experienced at some period of the journey they had all hatched upon arrival, so that none were sent out to correspondents that year.

In 1881 Hon. George B. Loring, of Massachusetts, was made Commissioner of Agriculture, and Professor Riley returned to office.

In 1882 trees were sent out to correspondents of the Department, and the report was made that among the Mennonites in one of the Western States mulberry trees had been planted in thick hedges at the limits of the fields and both sides of the highways and byways. The trees were cut down one-third at a time every three years, furnishing an abundant supply of fuel and also serving as windbreaks. These people had almost 20,000 pounds of cocoons on hand for sale.

In 1883 the State of California established a State board of silk culture at San Francisco, and the board offered premiums to the amount of $150 for the best cocoons raised in the State.

During the winter of 1883–84 the interest in the subject was so strong that Congress appropriated $15,000 to the Department of Agriculture for the encouragement and development of the industry. A special agent, Mr. Philip Walker, was appointed, who, under the direction of the Entomologist, devoted his whole time to the investigation of all subjects relating to the culture of the silkworm and the raising of raw silk.

Professor Riley stated in his report for 1884 that he had studied the status of the industry in southern France during the previous summer and was surprised to find it languishing on account of inability to compete with the silk produced by the cheaper labor of other countries. Professor Riley said: "If the French silk grower can not well cope with this competition with the price of ordinary labor at 3 francs for men and 1½ francs for women how can we expect to?" Our chief hope he considered to lie in the natural advantages which America possesses and in the Serrell automatic reeling machine, which he thought might revolutionize the silk industry and greatly subordinate the question of labor.

PROGRESS OF EXPERIMENTS.

In the spring of 1885 some 8,000 mulberry trees were distributed, as well as a quantity of silkworm eggs. No cocoons were bought by the Department, but examinations were made of home-raised eggs. Two stations had been established after the Congressional appropriation became available—one at Philadelphia and the other at New Orleans. At Philadelphia 518 pounds of cocoons were reeled, producing 96 pounds of raw silk. The quality of the cocoons handled was thus shown to be very bad. They cost on the average 85 cents per pound, so that the raw material used in the production of a pound of raw silk cost $4.58. The raw silk produced was sold for $4.40 per pound, by which it was shown that the cost of the raw material was greater than the value of the manufactured product. This result was laid to the inexperience of the raisers.

At the New Orleans station the filature was run from the 15th of April until the 31st of August; 3,360 pounds of cocoons were purchased, at an average of $1 per pound. From 2,710 pounds were produced 641 pounds of reeled silk, an average of 4.23 pounds of cocoons to 1 pound of silk. This showed a much better grade of cocoons than at Philadelphia. The average cost of the raw silk, however, including labor, was $5.90 per pound.

The California work during this year was reorganized, and there was reeled at San Francisco 44 pounds of silk. An effort was made during the winter of 1884–85 by Mr. Joseph Neumann and some others

to launch the "California Silk Culture Development Company," with a capital of $100,000, but the attempt was a failure.

It appears from the records that the appropriations given to the Department by Congress were expended during the fiscal year 1884–85 in support of the stations at Philadelphia and New Orleans and in the distribution of mulberry trees and eggs.

For the fiscal year 1885–86 Congress again appropriated $15,000. The reeling establishments in San Francisco, New Orleans, and Philadelphia were abandoned toward the close of the fiscal year. Silkworm eggs were distributed in the spring of 1886; circulars were sent out all over the country offering to purchase cocoons, and at the beginning of the fiscal year 1886–87 a Serrell automatic reel was set up under a new appropriation from Congress. Two Italian reelers were employed, and five American girls were instructed in the art of reeling. The result of this experience was to indicate a daily loss of $2.79, or approximately $1.50 per pound of silk produced, not including interest on capital invested or the cost of superintendence. The labor, however, was inexperienced, and improvements were possible in the machine, which were actually made at a later date. An effort was made during 1886 to ascertain the amount of the cocoons produced in the United States during that year. There were purchased at the Washington filature 1,313 pounds 15 ounces, valued at $1,272.04, and by the Women's Silk Culture Association at Philadelphia 3,081 pounds 9 ounces, valued at $2,720.88, making a total of 5,115 pounds 8 ounces, for which was paid $3,982.96, or nearly 78 cents per pound. These were obtained from 26 States and Territories.

In the spring of 1887, 150 ounces of eggs were distributed to 360 people, and the cocoon crop of the year was estimated at 6,174 pounds. The results of most of the raisers were very good, many persons having produced at the rate of 120 pounds of fresh cocoons for each ounce of eggs. In the meantime, however, reeling had been going on throughout the winter, beginning with October 30, 1886, and continuing at intervals until August 13, 1887. During this period 1,057 pounds of dried cocoons were consumed in the production of 263 pounds of reeled silk and 81⅝ pounds of waste. The quality of the cocoons was better than the previous year. The raw silk produced at the Washington filature during 1887 was sold for $864.81. During this same year the Kansas legislature, having established a station at Peabody, Kans., a filature of eight basins was started and information regarding the industry was disseminated throughout the State.

In the spring of 1888, again, 150 ounces of eggs were distributed, this time to 1,037 people, and the dried cocoon crop of the year was estimated at 3,913 pounds.

In 1887, 60 persons had received more than $10 each for their season's work, while 9 persons received more than $40 each. In 1888, however, only 48 persons received more than $10 each, and no one was paid as

much as $40. In 1887 the average price paid for each lot of cocoons was $7.81, and in 1888 it was $4.53. The Kansas State commission continued its work at Peabody and made material purchases of cocoons, but was cramped financially. The Silk Culture Association at Philadelphia, working under an appropriation of $5,000, continued the purchase of cocoons and reeling, and distributed over 5,000 mulberry trees. The California society received an appropriation of $2,500. The sales of raw silk as the result of the work of the Washington filature during the fiscal year ending June 30, 1888, amounted to $1,889.60. In the spring of 1889, 575 ounces of eggs were distributed, and the dried cocoon crop of the year was estimated at 6,248 pounds, amounting in fresh cocoons to 18,744 pounds. Of these, 11,805 pounds were purchased at the Washington filature, 3,002 at Philadelphia, and 3,936 at Peabody, Kans.

Mr. Walker, special agent of the Department, visited certain of the Western States and established stations for the purchase of fresh cocoons at St. Louis and at Newton, Kans.

In 1890, 800 ounces of eggs were distributed to 2,250 people, and the cocoon crop of the year was estimated at 16,953 pounds of fresh cocoons. During the fiscal year ending June 30, 1889, the Washington filature had sold raw silk of the value of $708.26, and during the fiscal year ending June 30, 1890, it sold $1,627.81 worth of raw silk.

Constant improvements had been made in the Serrell silk reel, both by Mr. Serrell in France and by Mr. Walker in Washington. Toward the close of 1889 Mr. Serrell had abandoned his experiments. Mr. Walker, while not abandoning the idea that ultimately an automatic silk reel could be perfected, was beginning by this time to show some discouragement in the possibility of establishing the industry.

DISCONTINUANCE OF APPROPRIATIONS AND INVESTIGATIONS.

The last appropriation made by Congress was $20,000 for the fiscal year ending June 30, 1891. An estimate for a continuance of this appropriation was made by the then Secretary of Agriculture, but the appropriation was not made by Congress, and the work of the Department in silk culture ceased for the time (June 30, 1891).

From that time on very little was done in the United States in the way of raising silkworms. The Utah people formed, during the nineties, a ladies' silk association. Five persons served as commissioners, and received pay from the State. In various parts of Utah, settled by the Mormons, an abundance of white mulberry trees had been planted. The new commission bought every year a supply of eggs, which were distributed in small lots among the Mormon settlers. In the course of time a number of women were selected from among the more skilled silk growers to go from place to place and teach the reeling of silk to children. They received no salary, and their only compensation was free board from the farmers. The reeled silk was

for a time sold in New York, but later the market was closed. In the meantime a small silk factory sprang up in Salt Lake City, which, in time, bought a small proportion of the silk produced in Utah. The cocoons were reeled upon hand reels built according to Japanese models, and a part of the raw silk was woven by the people themselves. Silk dyeing was not attempted, but the silk was sent to New York for that purpose.

RESUMPTION OF SILK INVESTIGATIONS BY DEPARTMENT OF AGRICULTURE.

In 1901 the present Secretary of Agriculture, who had been traveling extensively throughout the country, and particularly in the South, investigating agricultural conditions and possibilities, came to the conclusion that every possible effort should be made to ameliorate the condition of the extremely poor people of the Southern States, and particularly of the colored race. Among the many ideas which suggested themselves to him was that of silk culture, which he very well knew was a household industry in other countries and added materially, not only to the national wealth and prosperity of those countries in which it was carried on, but also to the family incomes of the extremely poor. He therefore, during the following session of Congress, asked for an appropriation of $10,000 for investigations in silk culture, which was allowed.

PURPOSE OF THE PRESENT INVESTIGATIONS.

The appropriation became available July 1, 1902, and the investigation was assigned to the Division of Entomology. The writer had been connected with the earlier work of the Department through his official position as first assistant entomologist, and was therefore thoroughly familiar with the conditions existing in the country, with the culture of silkworms, and with the difficulties in the way of establishing the industry. He realized the fact that practically no market for cocoons existed in the United States. He realized further that without such a market there is no inducement to create the supply. He realized also the practical impossibility of inducing the establishment of filatures without a guaranteed supply of cocoons. It seemed to him, therefore (and in all steps taken he has received the advice and approval of the Secretary of Agriculture), that the first step was to secure the planting of a sufficient number of mulberry trees in advantageous locations to feed the worms necessary to produce a commercial crop of cocoons; and further, to bring about the education of a sufficient number of people in the best methods of silk culture to guarantee a crop of high grade.

The first efforts of the Department were therefore directed, and are still being directed, to these ends. Large quantities of white mulberries grow here and there throughout the United States—some of them direct descendants from the Multicaulis cuttings set out in the early

Yearbook U. S. Dept. of Agriculture, 1903.

Mulberry Trees and Leaf Gatherers, Lombardy, Italy.

[Photographed August 26, 1902, by Dr. L. O. Howard.]

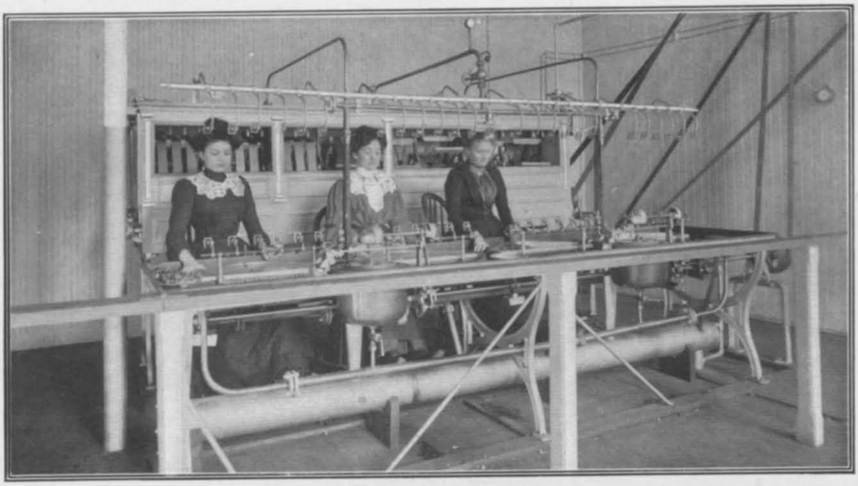


FIG. 1.—REEL IN OPERATION AT THE DEPARTMENT OF AGRICULTURE, WITH FRENCH AND ITALIAN OPERATORS.

[From photograph by F. M. Boteler.]

FIG. 2.—REELED AND WASTE SILK.

[From photograph by F. M. Boteler.]

thirties, others planted more or less by accident, and still others resulting from the efforts made by the Department in the eighties. The seeds of fruit from these old trees, discharged here and there by birds, have given rise in many places to great numbers of young mulberry trees. Mulberry bushes or scrub will be found growing at many points, particularly through the South. The trees in existence, however, have not been pruned or cultivated according to European methods, and can not be used to the very best advantage; yet there was a sufficient quantity of the mulberry trees already growing to raise a very large quantity of cocoons. Miss Henrietta Aiken Kelly, of Charleston, S. C., who had spent several years in France, Switzerland, and Italy studying scientific silk culture, including the care of the mulberry, raising the worms, and microscopic examination of the moths, according to the most approved Pasteur methods, for the purpose of detecting disease, was employed as silk-culture expert; her first work was the preparation of a manual giving simple but sound instructions for the raising of the worms. Mr. George W. Oliver, an expert horticulturist connected with the Bureau of Plant Industry, prepared a manual for growers of silkworm food plants, indicating the methods of caring for and cultivating the different varieties of mulberry. These manuals were printed and distributed widely during the winter of 1902-1903.

INSPECTION OF METHODS IN SOUTHERN EUROPE.

The writer visited southern Europe during the summer of 1902 and investigated silk culture in all of its phases; visited dealers in mulberry trees, and bacological establishments for the examination and sale of silkworm eggs and the manufacturers of silk-reeling machinery. Supplies of mulberry cuttings and silkworm eggs were secured from Europe during the late winter and early spring of 1903. Large quantities of mulberry cuttings were sent out to applicants, and in the later spring silkworm eggs were distributed in small individual lots to all applicants who were able to assure the Department that they possessed the requisite amount of available silkworm food. (Pl. VI.)

Congress during its session of 1902-1903 repeated the appropriation of $10,000, adding it to the clause making appropriations for entomological investigations, and under this appropriation the Division of Entomology is working at the time of the present writing.

In the early summer of 1903 there were imported from France two four-basin Berthaud reels of the latest and most approved style. One of these reels was loaned to the Seri-Culture and Manufacturing Company, at Tallulah Falls, Ga., but has not been used the present season. The other was set up at the Department of Agriculture in Washington and has been operated through the summer. With the assistance of United States Consul John C. Covert, of Lyons, France, two expert silk reelers were engaged and brought to the United States

for the purpose of operating the reel at Washington and of giving instruction in reeling. (Pls. VII and VIII.)

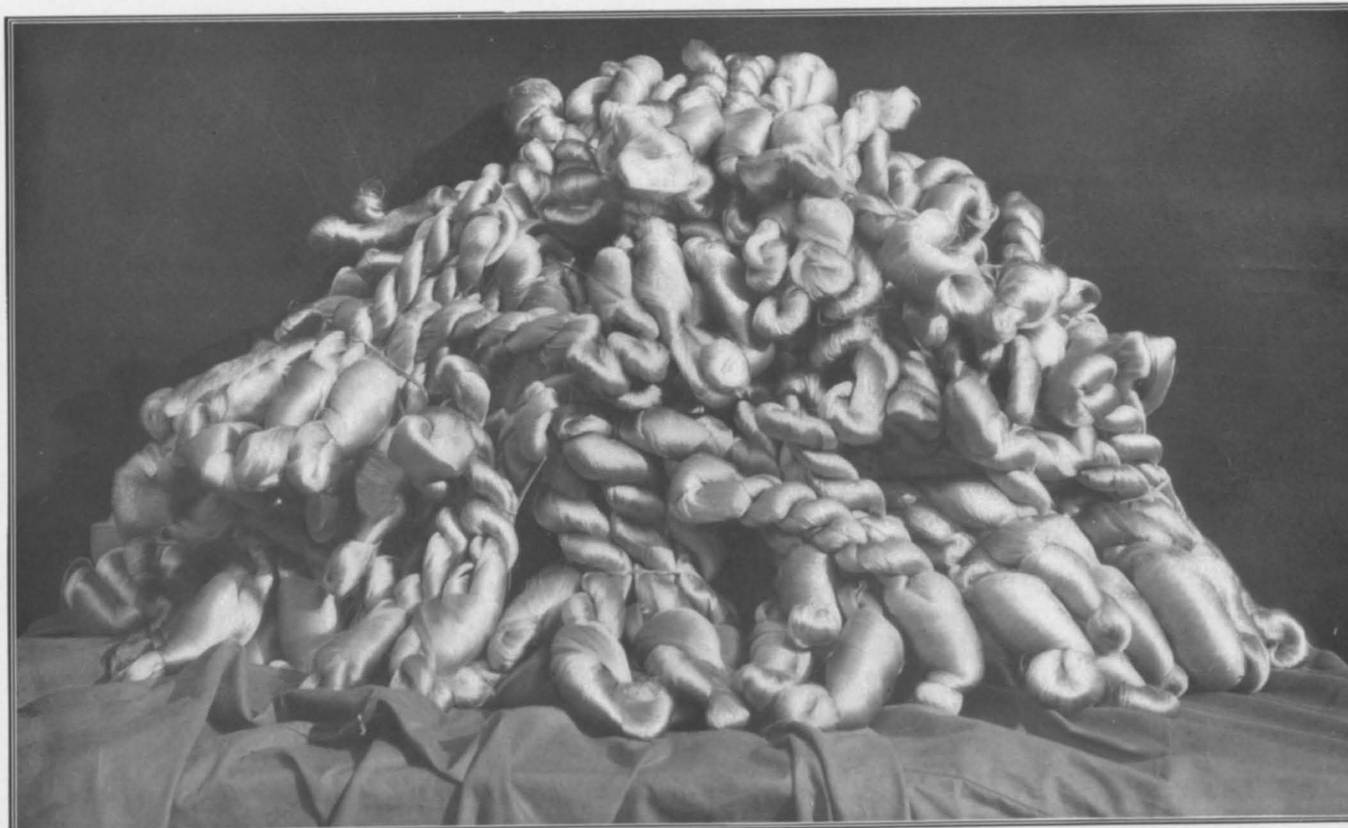
PURCHASE OF DOMESTIC COCOONS BY THE DEPARTMENT.

All of the correspondents to whom silkworm eggs were sent in the spring were notified that the Department would buy their cocoons at European market prices, and several hundred pounds were purchased in this way and were reeled during the summer. The raw silk thus produced, while excellent in quality, has not been large in quantity, and of course the expense of production has been prohibitive from a commercial point of view. It is the object of the Department in thus purchasing domestic cocoons to create what might be termed an artificial market for a time, in order to interest individuals throughout the country in learning the art of silk raising, to stimulate efforts in the production of the best possible cocoons (since the prices paid are graded), and to keep alive the interest, so far as possible, until the time comes when other and more natural markets shall be supplied.

From the experience of the Department in its early work and in the work of the past year and a half, it is plain that it is an easy matter to arouse an interest in silk culture. There are thousands of people in the United States who are eager to learn of some means of increasing their income by ever so slight an amount. It is not easy, however, to prevent the growth of extravagant ideas regarding the profits of silk culture. The majority of the people who write the Department about it have exaggerated ideas. Of those who begin the culture of the worm, many are so much disappointed by the meager sums which they receive from even the artificial market established by the Department that they abandon the work. Very many others, however, seem satisfied and interested, and at the present European market prices for cocoons it seems perfectly sure that enough people in the United States would take up silk culture and retain their interest in it to assure a very large annual crop. (Pls. IX and X.)

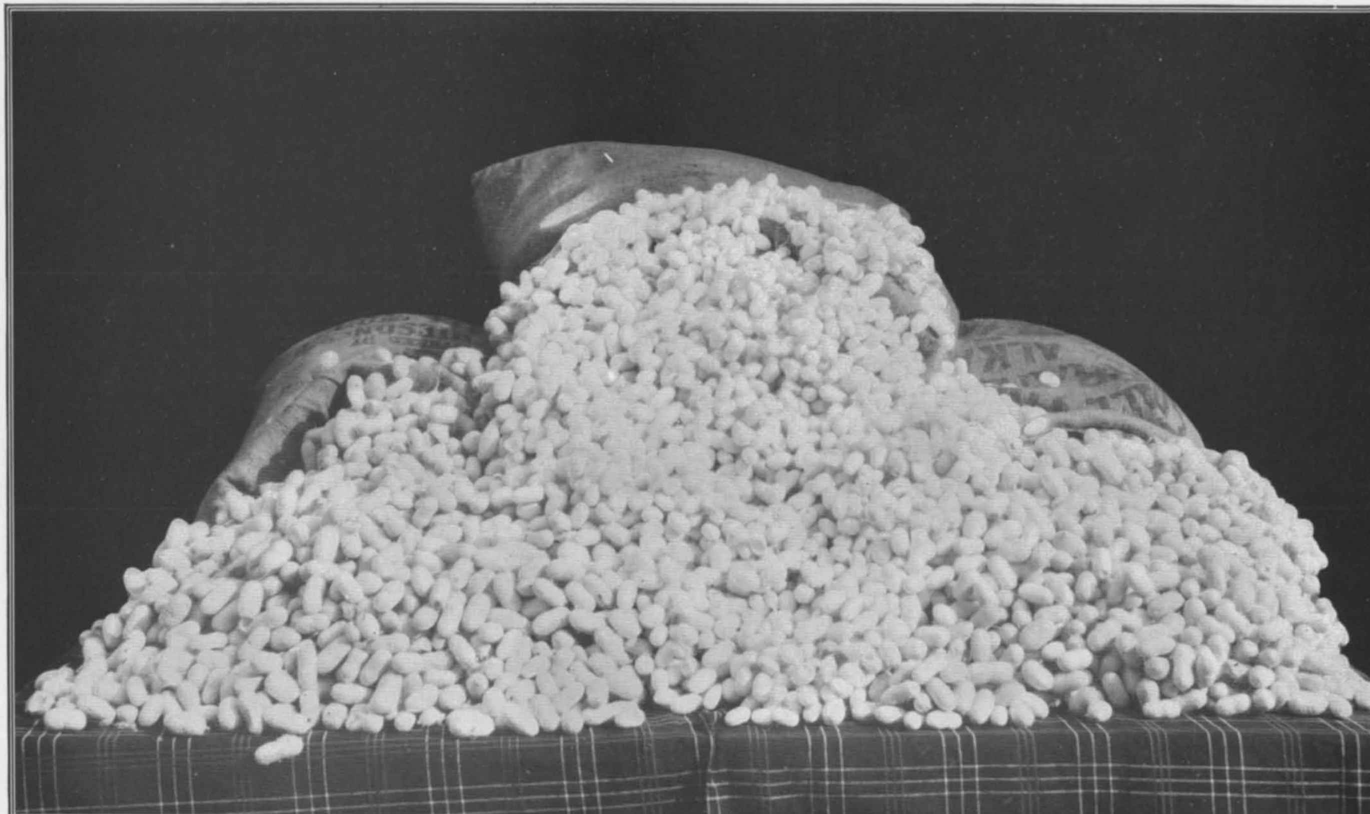
THE PROSPECTS FOR THE SILK INDUSTRY.

The Department, therefore, is justified in its initiatory effort to create the conditions for a constant supply of cocoons. It can keep up its reeling work and thus keep open practically the only market existing at present for a period which must be determined by the will of Congress. The outlook for what we have termed a more natural market is problematical. People interested in the promotion of silk culture are very hopeful, but advance few definite ideas. People interested in the manufacture of silk are pessimistic to the last degree. The vice-president of one of the large Eastern silk factories is reported to have said recently in southern California that if a warehouse full of cocoons were presented to him he could not afford to reel them at the present market price of raw silk. There is no doubt in the mind of



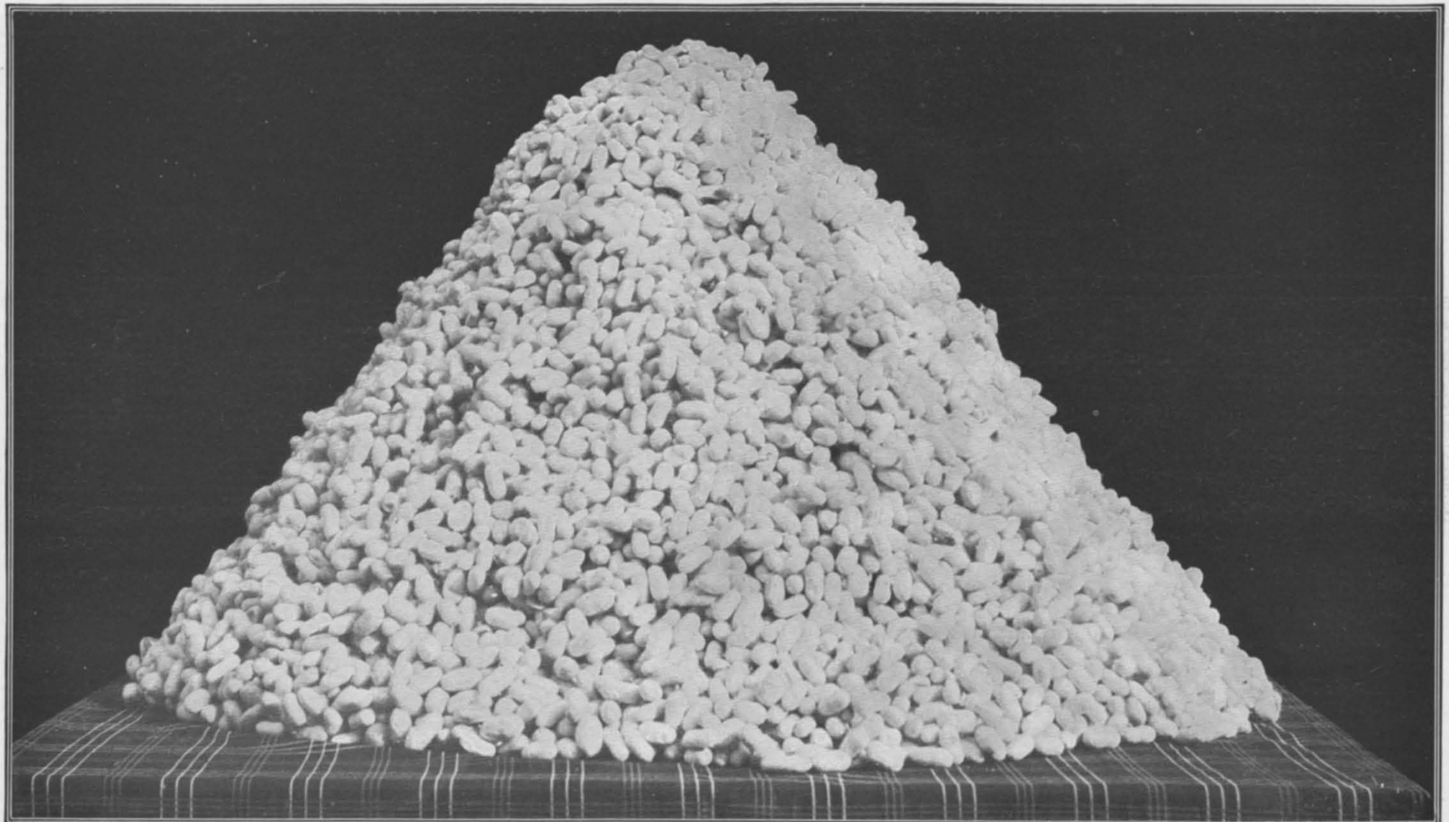
Silk Reeled at the Department of Agriculture from American-grown Cocoons.

[From photograph by F. M. Böteler.]



AMERICAN-GROWN COCOONS USED IN THE REELING EXPERIMENTS OF THE DEPARTMENT OF AGRICULTURE.

[From photograph by F. M. Boteler.]



AMERICAN-GROWN COCOONS USED IN THE REELING EXPERIMENTS OF THE DEPARTMENT OF AGRICULTURE.

[From photograph by F. M. Boteler.]

the writer that this is an extreme and exaggerated statement. The work of the Department in the eighties with the improved Serrell automatic reel, it is true, indicated a rather serious loss in the reeling operation, but the reel used was one of only six basins, and it is a well-understood fact in European reeling centers that an establishment of less than twenty-eight basins can not expect to pay running expenses. Economies enter into the administration of large establishments which vitally affect the question of profits. There are many portions of the United States well adapted to silk raising, many places which might well become silk centers, where labor can be employed practically at rates comparable to those of southern Europe. The establishment of a silk mill in such a location, with its own filature attached, with the surrounding people employed as operatives in both filature and mills, and with the otherwise unoccupied members of their households engaged in silk raising in the spring, is feasible, and can be made to pay. A beginning of this kind may possibly soon be made by foreign capital. The proprietor of a large estate in Italy is at present giving the matter serious consideration. A foreign proprietor of a silk establishment in one of our larger Northern cities states that he can count upon the employment of 5,000 of his compatriots more or less skilled in the silk industry at an average daily wage of from 20 to 25 cents. He himself would enter upon such an enterprise with an assured crop of cocoons.

That in some of these ways the natural market will come seems possible, and even more than possible. What the success of silk culture would mean to the United States is indicated by the following table, which shows the importations of raw silk into the United States during the years 1892 to 1902:

Importation of raw silk (as reeled from the cocoon), 1892–1902.[a]

QUANTITY.

Countries from which imported.	1892	1893	1894	1895	1896	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
France	319, 673	307, 872	210, 813	365, 986	381, 749	233, 005
Germany	2, 681			220	1, 311	3, 818
Italy	1, 275, 274	1, 482, 444	886, 328	1, 354, 478	1, 116, 239	865, 972
Switzerland	662	2, 406			22	
Turkey in Europe	4, 997	7, 101		935	221	5
United Kingdom	7, 592	34, 392	3, 165	13, 953	18, 317	1, 373
Bermuda		90				
Dominion of Canada (Quebec, Ontario, Manitoba, etc.)	1, 195	687	47		12, 477	
Chinese Empire	1, 845, 555	1, 880, 242	1, 198, 304	2, 419, 128	2, 315, 873	1, 907, 892
East Indies—British	921	9, 509	13, 830	1, 463	1, 352	
Hongkong				30, 476	201, 680	26, 682
Japan	4, 062, 362	3, 697, 675	2, 644, 388	3, 788, 171	3, 951, 380	3, 474, 865
Turkey in Asia	430	12				
Total	7, 521, 342	7, 422, 430	4, 956, 875	7, 974, 810	8, 000, 621	6, 513, 612

[a] Treasury Department, Bureau of Statistics, Report on Commerce and Navigation for 1902, Vol. II, pp. 228, 229.

Importatio (*as reeled from the cocoon*), *1892–1902*—Continued.

QUANTITY—Continued.

Countries from which imported.	1898	1899	1900	1901	1902
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
France	339,934	330,248	356,145	322,718	550,566
Germany	....	285	3,022	560	7,622
Italy	1,743,543	2,251,216	2,217,879	1,832,581	2,567,752
Switzerland	3,722	1,320	8,651	402	3,900
Turkey in Europe	....	....	....	....	11
United Kingdom	552	244	5,532	2,747	370
Bermuda	....	....	....	....	....
Dominion of Canada (Quebec, Ontario, Manitoba, etc.)	16,252	4,699	36,462	18,713	256,703
Chinese Empire	2,916,549	2,512,299	3,854,657	2,290,680	3,027,608
East Indies—British	151	149	6,951	13,102	8,295
Hongkong	30	75,569	4,920	....	....
Japan	5,294,429	4,515,116	4,765,091	4,658,111	6,197,795
Turkey in Asia	....	....	....	....	60
Total	10,315,162	9,691,145	11,259,310	9,139,617	12,620,682

VALUE.

Countries from which imported.	1892	1893	1894	1895	1896	1897
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
France	1,154,087	1,383,377	840,338	1,235,815	1,465,405	751,846
Germany	10,582	....	....	350	4,928	13,991
Italy	4,912,495	7,303,239	3,628,864	4,899,330	4,587,761	3,019,515
Switzerland	2,088	12,932	....	....	68	....
Turkey in Europe	17,023	26,173	....	2,683	660	16
United Kingdom	12,434	84,716	6,083	39,527	59,109	5,550
Bermuda	....	195	....	....	....	....
Dominion of Canada (Quebec, Ontario, Manitoba, etc.)	4,510	3,741	281	....	43,141	....
Chinese Empire	5,087,858	5,427,531	3,087,749	5,511,960	6,622,692	4,642,457
East Indies—British	2,323	29,159	39,764	2,993	3,734	....
Hongkong	....	....	....	51,612	540,814	52,684
Japan	13,116,579	14,784,432	8,024,743	10,284,798	12,918,590	10,010,885
Turkey in Asia	1,515	62	....	....	....	....
Total	24,321,494	29,055,557	15,627,822	22,029,068	26,246,902	18,496,944

Countries from which imported.	1898	1899	1900	1901	1902
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
France	1,192,058	1,248,037	1,607,569	1,220,874	1,866,202
Germany	....	1,101	19,480	2,386	29,106
Italy	6,227,004	8,929,776	10,816,084	7,151,438	9,954,501
Switzerland	9,194	4,133	40,950	681	17,422
Turkey in Europe	....	....	....	....	38
United Kingdom	1,752	956	7,301	9,763	1,421
Bermuda	....	....	....	....	....
Dominion of Canada (Quebec, Ontario, Manitoba, etc.)	56,468	18,296	157,161	60,109	807,706
Chinese Empire	7,506,409	6,497,983	12,171,309	6,303,523	8,308,383
East Indies—British	389	476	24,659	33,456	27,190
Hongkong	120	205,516	17,027	....	....
Japan	16,453,406	14,920,787	19,686,132	14,571,547	20,702,101
Turkey in Asia	....	....	....	....	261
Total	31,446,800	31,827,061	44,549,672	29,353,777	41,714,331

THE FARMERS' INSTITUTES.

By John Hamilton,
Farmers' Institute Specialist, Office of Experiment Stations.

THE DEVELOPMENT OF FARMERS' INSTITUTES.

Farmers' institutes are now held in all of the States except Arkansas, Montana, and South Dakota, and in all of the Territories except Alaska, Porto Rico, and Indian Territory. In no two of the States are institutes organized in the same manner or conducted by the same methods. In some the management is under the control of a central board, or institute official. Others have no central organization, but each county institute is an independent unit. Others have both a central organization and local boards, each having distinct powers and being charged with specific duties. In some States the local organizations are created by legislative acts under State laws, and consequently have continuous existence. In others they are without legal status, and are temporary in character, new associations for institute purposes being formed each year.

This diversity is due to the fact that the work is new, and its development has been by independent action by the several States, without conference, and in many instances without precedent for their guidance.

EFFORTS AT UNIFORMITY IN INSTITUTE WORK.

The first attempt in the direction of securing uniformity of method in institute work was made in 1896, when Supt. George McKerrow, of Wisconsin, called a meeting of the institute workers of the country for March 13 of that year, to be held at Watertown, Wis. At this meeting a form of constitution was prepared to be submitted to a subsequent convention to be held October 14, 1896, in Chicago. At the Chicago meeting a new constitution was presented as a substitute for the one prepared at Watertown, and after extended discussion the substitute was finally adopted. The name given to the organization was "The American Association of Farmers' Institute Managers."[a]

The condition of the institute work at that time was summed up by one of the speakers in the following statement:

> As States we have been pursuing different lines with different objects in view, but in the future we should endeavor to unify our plans of work by discussing methods, criticising pet theories, and subjecting the plans followed by the various States to a sort of surgical treatment of the work and the workers. If this is done thoroughly, we can unite upon a common method which will be of great benefit to all.

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[a] Subsequently changed to the American Association of Farmers' Institute Workers.

In furtherance of the purpose of the organization to secure greater uniformity, the association at its meeting in Columbus, Ohio, in 1897, by formal action requested the Secretary of Agriculture of the United States to "arrange for a division in connection with that Department, to be known as the Division of Farmers' Institutes, and to appoint a suitable officer who shall be in charge."

The Secretary of Agriculture at the second session of the Fifty-seventh Congress made request for an appropriation of $5,000 for the purpose of enabling the Department to engage the services of some one to cooperate with the State directors, and to render such other assistance as the Department might be able to furnish. Congress made the appropriation, and an official known as Farmers' Institute Specialist was accordingly appointed, who took charge of the work under the direction of the Office of Experiment Stations on the 1st of April, 1903.

The act providing for the appointment makes it the duty of this officer to "investigate and report upon the organization and progress of farmers' institutes in the several States and Territories, and upon similar organizations in foreign countries; with special suggestions of plans and methods for making such organizations more effective for the dissemination of the results of the work of the Department of Agriculture and of the experiment stations, and of improved methods of agricultural practice."

FEATURES OF WORK COMMON TO ALL INSTITUTES.

Notwithstanding the diversity that has existed in many respects among the directors in conducting their institutes, two leading features of the work have been common to all, and are the distinguishing characteristics. The first is an earnest purpose to carry valuable agricultural information to farming people at their homes, and the second is to effect this by means of oral instruction given by capable teachers in institute assemblies.

The faithful carrying out of these purposes will, as the work develops, and as the practice pursued in the several States becomes generally understood by the directors, naturally cause them to adopt such common methods as experience has shown to be best adapted to the accomplishment of the ends in view. These efforts, assisted by the two agencies referred to, the American Association of Farmers' Institute Workers and the Office of Experiment Stations, through its farmers' institute specialist, it is believed will secure in the near future such a degree of cooperation as will lead ultimately to substantial uniformity of methods throughout the country. The extent to which the Department of Agriculture can aid in bringing about this result is indicated in the following extract from the report of the

Director of the Office of Experiment Stations for 1903, in which he outlines the general policy to be pursued respecting the institute work:

> Since the work of this Department relating to the farmers' institutes is based on the principle of giving aid to the institutions maintained under the authority of the States, this Office has established the rule of working in this line through the State officers charged with the management of the institutes. It is the intention to consult freely with these officers, to welcome suggestions from them regarding the development of our work, and to recognize them as the proper authorities through whom to deal in matters relating to the institutes in the several States. It is our purpose to endeavor to strengthen the State organizations for the management of the institutes, and to create a National system of institutes by promoting the reasonable coordination of the work throughout the country, and the cooperation of the State organizations without weakening or destroying their autonomy.

Those most in need of immediate assistance are the State directors, or persons in general control of the institutes in the several States, the local managers, and the lecturers or teachers who are engaged in giving instruction in agriculture at institute meetings.

The State directors need help along the line of organizing their work that it may be most effective as an educational institution for the benefit of agriculture; the local managers need assistance in arranging for the institutes in the several localities in the matter of advertising, preparing programmes, providing proper local committees to look after minor details, such as the question box, the entertainment of visitors, the collecting of exhibits for display at institutes, the securing of suitable halls for the meetings, and other matters of like character; and the lecturers need assistance in the direction of their proper equipment as teachers of agriculture. How most effectively to assist these three great classes of workers in their efforts to elevate agriculture into a more scientific and remunerative profession is the institute problem which the Department, through its Office of Experiment Stations, has undertaken to solve.

GROWTH OF INTEREST IN FARMERS' INSTITUTES.

The interest manifested in the farmers' institutes is seen in the action of the legislatures of the several States and of the agricultural college and experiment station officers having charge of the work in making appropriations for their support. Amounts varying from $35 in the Territory of Hawaii to $20,000 in the State of New York show the extremes, the aggregate for the 45 States and Territories which reported the past season being $187,226. The appropriations for the coming season, as shown by the reports of 40 States and Territories, amount to $210,975. If the States not reporting appropriate sums equal to those expended by them in 1903, the total for 1904 will reach $214,729, or $27,503 more than was appropriated for the year just closed.

It is noticeable that where the institutes have been longest in operation the appropriations are correspondingly large: New York, $20,000; Pennsylvania, $17,500; Ohio, $16,981; Wisconsin, $12,000; Illinois, $18,150; Indiana, $10,000; Minnesota, $16,500; Michigan, $7,500. Other States with smaller agricultural populations have been proportionately liberal: West Virginia, $5,451; Vermont, $5,000; Maryland, $4,000; Maine, $3,000; Florida, $2,500, and California, $4,000.

The attendance has also been increasing each year, that of the season just closed being 904,654, as against 819,999 for the previous year. The real advance numerically is, however, greater than these figures indicate. Upon the recommendation of the American Association of Farmers' Institute Workers, the method of computing attendance has recently been changed, with the result of reducing the number reported in attendance in 1902, in four States, by 99,481. The fact that these four States held 126 more institutes in 1903 than in 1902 shows that the falling off, as reported, was not actual, but is due to the method of computing attendance. If this correction is made, the attendance for the present year exceeds that of the year previous by 184,136. This increase was for the most part in the following States: Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, and Pennsylvania.

The increase in the number of institute meetings is another evidence of progress. There were 415 more institutes held this year than last, the figures being 3,179 for the year ended June 30, 1903, and 2,764 for the year ended June 30, 1902. Of the 3,179 institutes held, 1,359 were one-day institutes, 1,637 covered two days, and 77 three days and over. A more accurate understanding of the amount of work accomplished can be had from the number of sessions held, which amounted to 9,570 during the year.

THE LECTURE FORCE.

The meetings held during the season of 1902–1903 were addressed by 924 lecturers employed by the State directors, and by about three times as many more employed by the local managers, approximating 4,000 persons who gave instruction at institutes last year. One hundred and ninety-six of these were members of the staffs of agricultural colleges or experiment stations, who contributed 1,666 days of time to this work, attending in all 752 institutes.

The lecture method is used in giving instruction at the institutes, the lectures being followed by an informal discussion of the topics by the audience. These informal discussions are valuable and distinguishing features of the institutes. Any new theory or improved method suggested is thereby subjected to the scrutiny and criticism of practical men, many of whom have had a lifetime of experience along the line of the speaker's topic, and so are well qualified to discuss from a

practical standpoint the subjects presented and to call attention to any impracticable features advocated by the lecturers that might prevent their adoption by the general farmer. The effect of this critical discussion is to drive the uninformed and ill-balanced lecturer from the platform, and gradually to secure for institute service a corps composed of well-qualified and conservative teachers.

That this sifting process occurs is shown by the character of the lecture force as it now exists in this country. An examination of the personal history of 623 lecturers engaged in the farmers' institutes in the United States showed that 287 had college degrees, 138 had taken partial college courses, 108 had the advantage of normal or high-school training, and 90 were practical men who had ordinary educational advantages. The men, therefore, who are now giving instruction in the farmers' institutes in this country are for the most part unusually well qualified for their work. The progress made in this respect is most striking if the qualifications of the lecture force of to-day are compared with those of the average lecturer of fifteen years ago.

TRAINING LECTURERS.

It is manifest that the extension of the institutes will be limited by the ability to secure a sufficient number of capable teachers. Thus far the State directors have depended upon the agricultural colleges and the experiment stations for their supply of men for expert scientific teaching, and upon the more intelligent and successful practical farmers for giving information in regard to conducting the practical operations of agriculture.

A number of State directors appear to have given little attention to securing a supply of lecturers from among citizens of their own States, but have depended upon the services of men of reputation from other States. Some directors, on the other hand, have striven to develop capable teachers for institute work by selecting men in their own State who have succeeded in some line of agricultural practice, and giving them the opportunity of telling institute audiences the results of their own experience. In this way many excellent teachers have been secured and added to the force.

That each State director should adopt some method for discovering capable men to be developed into competent instructors is clear, for unless the teaching force can be constantly recruited and maintained at a high standard of efficiency the work must necessarily deteriorate and eventually become of little benefit to agriculture. The Office of Experiment Stations of the Department of Agriculture has taken up this question, and is now sending out to the State lecturers lists of the Department publications, from which they can select such bulletins as promise to be of assistance to them in the study of their several specialties. The agricultural experiment stations are cooperating in this work.

How far the agricultural colleges or experiment stations can go, or ought to go, in preparing men and women specially for institute work should be seriously considered by the officers of these institutions. Illinois, Michigan, New York, Tennessee, and Wisconsin have already started a movement in this direction. The plan pursued by these institutions consists in general of courses of lectures by members of the agricultural college and experiment station staffs delivered to the institute teachers of the State, continuing for from one to two weeks, with a view to acquainting them with the more important scientific truths relating to their specialties. A number of the presidents of agricultural colleges in other States have expressed their interest in this effort to educate institute teachers, and no doubt the next few years will develop, in connection with these colleges, some system that will be practicable and otherwise satisfactory in this direction.

MANAGEMENT OF INSTITUTES.

In 27 States directors complete all arrangements for the holding of institutes, fixing the dates and places, and arranging the programmes. In 13 States one or more leading topics are prescribed by the State director to be discussed in all institutes held during the season. By this method it has been found possible to disseminate over the entire State accurate information in regard to subjects of special importance in a single year.

In 29 States the directors publish in advance of the beginning of the institute season an announcement of the dates, places, and speakers. In 10 States no such announcement is made. Twenty-four State directors attend all or nearly all of their institutes, and 21 directors permit their names to be placed regularly on the programmes of exercises.

Special institutes for women are held in 15 States. In 43 States the agricultural colleges and experiment stations furnish lecturers for institute work. In 14 States annual round-up institutes are held, and 20 States publish reports of proceedings, aggregating last year 253,700 copies.

THE COST OF INSTITUTES.

Of the institutes held last year, 3,106 have reported their expenses, showing an average cost of $60.22 for each institute; 9,426 sessions cost an average of $16.85 per session, varying from $3 to $82 as the extremes. There were 4,864 days of institutes in all. The cost of 4,792 of these was at the rate of $39 per day, and the average cost per person for the year was about 2.2 cents.

In 33 out of the 44 States reporting, the institutes are supported by appropriations by the States; 10 by local subscriptions or by agricultural college or experiment station assistance; and one receives appropriations from both the State and the agricultural college.

In 10 of the States no compensation is allowed to the lecturers outside of their necessary hotel and traveling expenses. In 22 States the remuneration of the lecturers ranges from $2 per day to $50 per week and expenses.

ASSISTING FARMERS' BOYS.

The work of the institute thus far has been mainly directed and planned to meet the needs of the practical farmer. The programme, the question box, the discussions by experts, have all been arranged and conducted with special reference to interesting and instructing adults, with the natural result that the institute halls are filled for the most part by gray-haired men and middle-aged women, with only here and there a farmer boy or girl.

Some managers have recognized the importance of their institutes doing something for the improvement of country children, and accordingly have arranged for holding meetings to which country boys and girls are invited, and at which they are called on to read essays or recite selections, often upon subjects having little or no direct relation to farm life. It not infrequently occurs that when such a session has been concluded none of the young people who have participated has acquired any additional knowledge of agricultural affairs or received a stimulus to a study of any problem connected with farm life.

A new movement has recently been inaugurated with the purpose of rendering the institutes specially interesting and at the same time directly useful to country children. At least three States have begun work in this direction with satisfactory results. The plans adopted are essentially the same, differing only in minor details.

A brief outline of the system at present in operation in Illinois will serve as an illustration of what is being undertaken:

Packages, each containing 500 grains of seed corn of some approved variety, are sent out by the State director of farmers' institutes to as many boys throughout the State as will agree to enter the contest. The conditions are that a boy receiving a package "shall plant 300 grains of the seed in a square, with the balance planted in two rows on the south and west sides to fertilize and protect the inside rows; that he will cultivate and harvest it and exhibit not less than ten ears of it at his home county farmers' institute, the ten ears or more for exhibition to be taken from the inside square. It is further agreed by the boy receiving the corn that he will comply with the rules governing the exhibit of corn at his county institute, and that he will attend at least one session of the institute." Each boy is required to keep a record of the crop and report to the institute on the following items:

The kind of soil upon which the corn was grown; the previous crop upon the plot; the manure used, if any; the time and depth of plowing; the cultivation of the ground

before planting; the time of planting; the number of times and kind of cultivation; the implements used in cultivation; the number of hills; the number of stalks in each hill; the number of ears; the number of stalks that were without ears; the total weight at the time of gathering; the injury from cutworms and insects. All to pertain only to the hills from the 300 grains on the inside square planted.

The ten ears exhibited are expected to be uniform in appearance, true to type, to have the rows of kernels straight and parallel with the cob, and each ear to carry the same circumference from butt to tip.

The judging is performed by persons selected by the local board of county institute officers, usually some one who has taken and passed the Illinois Corn Growers' examination for skill in corn judging. The standard of excellence is fixed by the following scale of points adopted by the Illinois Corn Growers' Association:

Scale of points in judging corn.

	Points.
Uniformity of exhibit [Uniform type, size, shape, color, and indentation.]	10
Shape of ears [Cylindrical, straight rows, proportional length to circumference.]	5
Color of ears [Uniform.]	10
Market condition [Soundness, freedom from injury, maturity.]	10
Tips of ears [Filled out with regular-sized kernels.]	10
Butts of ears [Kernels swelled out about shank regularly.]	5
Uniformity of kernels [In type, shape, and color.]	5
Shape of kernels [Wedge shape, straight edges.]	5
Length of ears [Conformity to standard.]	10
Circumference of ears [Conformity to standard.]	5
Space between rows [Small.]	5
Space between kernels [Small.]	5
Per cent of corn [Conformity to standard.]	15

Rules for judging corn.

(1) The excess and deficiency in length of all ears shall be added, and for every inch thus obtained cut one point.

(2) The excess and deficiency in circumference of all ears shall be added, and for every inch thus obtained a cut of one-half point shall be made.

(3) For every per cent short of standard in proportion of shelled corn a cut of one point shall be made.

The contest is confined to boys not over 18 years of age. Premiums are offered by the county institutes for the best samples of corn

exhibited, and also for the best report presented on the method of growing the crop. These premiums usually consist of some animal or article closely related to farm life, such as a well-bred calf, pig, or lamb; some farm implement; a library of selected agricultural books; an assortment of fruit trees; a collection of seeds of special worth; and choice varieties of plants, such as strawberries, small fruits, or ornamental shrubs or trees.

In one county an entire day of the institute is set apart to be known as "boys' day," and the county superintendent of public instruction recommends that the public schools be closed on the day of the boys' programme, and that teachers and children attend the institute.

It is manifest that while the State from which this example has been taken has confined the contest to the single item of Indian corn, the principle is, nevertheless, capable of being applied in many directions, embracing other crops, the growing of animals, the improvement of home surroundings, the manufacture of butter or cheese, or the care of poultry.

The experiment is full of suggestions, and no doubt other State directors will, as the success of these trials becomes assured, adopt similar means for improving their institutes so as more effectively to educate and interest the youth in their several States in agriculture.

IMPROVEMENT OF THE INSTITUTES.

In the early stages of the institute work, and with the limited means at the disposal of the managers, the holding of a few meetings was about all that could be undertaken, but now with more funds, increased interest, and clearer views of what the institute stands for, it ought to be possible in many States to do much more. Hitherto many institute managers have seemed to feel that they had performed all of the service required when they had held successfully in their county two, three, or four institutes a year. As soon as these were over, the local institute force either entirely disbanded or settled back into a state of comparative inertia until the time was near for the next year's meetings, when a new campaign had to be organized and the public again be awakened to renewed interest in the work.

Many of the most advanced institute workers have come to the conviction that the institute work has reached a stage of progress when there should be such a degree of stability in the organization of the local institute as will keep it not only in existence during the entire year, but energetically at work as well. Delaware, Illinois, Kansas, Michigan, Ohio, and Oklahoma already have county institutes which are constituted under their laws and have continuous existence. In these States the county institute organizations are responsible to a State director or central board, and yet they have sufficient independence of action to make it impossible for any change in the personnel

of the State directory to affect their integrity. Work undertaken by these local organizations for the improvement of home conditions can not be seriously interfered with by any change occurring in the State administration. This is a great improvement over the system most common, where there is either no local organization or one that is so temporary as to virtually cease to exist at the end of the institute season. The loss by death or removal of the State director in such instances is always attended with great inconvenience, and sometimes is a serious permanent injury to the work.

The establishing of a properly constituted local organization in each county has undoubtedly tended to strengthen the institutes wherever the plan has been introduced, and has made possible their expansion to meet the constantly increasing needs of the people for institute service. One direction in which such a system can be of service is shown in the Province of Ontario, Canada, where similar local permanent organizations cooperate with their experiment stations in testing the adaptability of various seeds and plants to the several districts. The report of the Experimental Union for 1903 shows that during the previous year 3,845 different persons had cooperated with their stations in conducting experiment work in agriculture.

The subjects of interest to country people which are important, and which would furnish work for the institutes during the intervals between the lecture seasons, are quite numerous. They include the preparing of the way for the introduction of the teaching of agriculture in the rural schools, the betterment of the public roads, the improvement of the live stock of the county, the securing of better county fairs, and the introduction of new and valuable varieties of seeds and plants. These and many others are subjects needing attention in every rural community, and a well-organized permanent county institute would be constantly on hand with a selected force of men and women ready to help.

The new field which the institutes thus organized could enter would expand their work far beyond its present bounds, and would compensate for some of the loss which the lack of a sufficient number of high-grade teachers has occasioned. Institute managers are now greatly embarrassed in their efforts to extend their work upward along the lines originally laid out. The broadening of the work so as to reach all of the citizens in every county during the entire year, and then reaching down and assisting country children to a better appreciation of their life and surroundings, will relieve much of this embarrassment and bring about an improvement that is urgently needed in every community in every State.

SOME RESULTS OF INVESTIGATIONS IN SOIL MANAGEMENT.

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ADVANTAGES OF THOROUGH CULTIVATION IN THE SOUTH.

The close structure and feeble granulation of very many of the soils in the South, combined with the heavy, intermittent character of the rainfall, make it a matter of great importance for most intertilled crops like corn, cotton, and potatoes that the fields receive frequent thorough cultivation to a depth of 3 inches. This is needed (1) to lessen the bad effects of drought by reducing surface evaporation; (2) to prevent the plant food in solution being carried, by excessive capillary rise, too near the surface, above the zone of roots, and to obviate its being left by evaporation where the heavy rains will dissolve it and carry it into the surface drainage; (3) to give better circulation of air in the soil, which roots and soil organisms require; and, (4) to allow more of every heavy rain at once to enter the soil deeply, and thus lessen the loss of fertility by surface washing.

Proper attention to these matters is more imperative in the South than in the North, because of the higher soil temperatures, which hasten evaporation, and because of the lesser depth to which the roots of crops penetrate the soils.

LOSS OF WATER BY EVAPORATION FROM SOUTHERN SOILS.

In the following table is shown the evaporation from the surfaces of six soil types in the Goldsboro, N. C., area, during twenty-eight days, from July 17 to August 14, 1902, inclusive:

Comparison of evaporation from compact and loose surfaces of six soil types.

Surface condition.	Type of soil.					
	Sandhill.	Selma silt loam.	Pocoson.	Norfolk sandy soil.	Goldsboro compact sandy loam.	Norfolk fine sandy loam.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Surface firm	1.880	2.895	3.355	4.170	5.345	6.515
Surface loose, 3 inches	.205	.775	.930	.770	.880	1.135
Amount saved by 3-inch mulch	1.675	2.120	2.425	3.400	4.465	5.380

In these cases the soils were all placed under identical conditions, with the ground-water level in the soil maintained at 20 to 24 inches below the surface. It will be seen that 3-inch soil mulches, such as are developed by careful cultivation, have exerted a very strong influence in lessening the capillary rise of water to the surface, where it is lost by evaporation, and also that there is a marked difference in the rate of capillary rise and loss of moisture from the surface in the different soil types, it being strongest in the Norfolk fine sandy loam. It is important to observe, too, in the case of the Pocoson and Selma silt loam (the two soils having the highest content of humus) that they stand next to the sand in the rate of capillary rise and loss of water from the surface. In this feature they resemble the humus soils of the North, which lose water much more slowly than other soils do through capillary rise and evaporation. If it shall be proved that the presence of organic matter in soils in the undecomposed form tends to decrease the rate of capillary rise to the surface and loss of water by evaporation, it will explain in part the observed fact that stable manures keep the surface foot of soil more moist, and it will emphasize the importance of increasing the generally too small amount of organic matter in Southern soils.

The observed evaporation during the hot months of July and August for the six soils stand, per one hundred days, from the wet unmulched surfaces, at the rates of 6.71, 10.34, 11.98, 14.89, 19.09, and 23.27 inches, given in the order named in the table; while from the loose mulched surface the rates were only 0.73, 2.77, 3.32, 2.75, 3.14, and 4.05 inches, per one hundred days, named in the same order.

The rates of evaporation first given above are larger than the averages which occur under field conditions, except during drying days, when the soils are wet at the surface, and the second series of figures express lower rates than occur under average field conditions, except when the soil surfaces are dry and loose; but the second series does show the relative differences between the different soil types named, and demonstrates the importance of maintaining, by good cultivation, the proper condition for the surface 3 inches of soil over intertilled fields.

CULTIVATION TO MAKE WATER-SOLUBLE PLANT FOOD AVAILABLE.

There is another very important influence which thorough cultivation exerts as a result of its check on evaporation from the soil surface, and that is the lessening of the rate of rise of plant food in water-soluble form directly to the surface, above the reach of roots, where, especially in the South, it is in danger of being lost in the surface drainage during heavy rains. It was found, for example, at the close of the experiments in which the influence of mulches on evaporation

was measured, that the water-soluble salts had moved upward at quite different rates under the two conditions of surface. The total amounts of nitrates, phosphates, and sulphates which could be recovered by washing the surface inch of soil three minutes in distilled water are given in the following table:

Influence of mulches in restraining the capillary rise of salts to the surface.

Soil type.	Nitrates.		Sulphates.		Phosphates.	
	Unmulched.	Mulched.	Unmulched.	Mulched.	Unmulched.	Mulched.
	Pounds per acre.	*Pounds per acre.*	*Pounds per acre.*	*Pounds per acre.*	*Pounds per acre.*	*Pounds per acre.*
Sandhill	5.89	0.55	2.32	0.92	2.24	1.45
Selma silt loam	335.28	218.33	312.67	106.13	5.57	3.19
Norfolk sandy soil	252.91	158.40	189.55	118.54	5.10	2.51
Goldsboro compact sandy loam	159.46	67.06	333.17	31.94	4.59	2.69
Norfolk fine sandy loam	428.74	176.35	115.37	85.27	4.49	2.24
Pocoson	257.23	172.39	73.13	21.39	4.86	2.77

From this table it is seen that relatively much larger amounts of each of these salts have been carried into the surface inch of soil in the cases where the soil has not been left loose.

When the mean amounts of salts for the six soil types in the surface 3 inches (the full depth of the mulch) are compared they stand 746.1 pounds per acre of nitrates where there was no mulch to 483 pounds where the soil was maintained loose to a depth of 3 inches; that is to say, the mulch has not only conserved the soil moisture in a very marked degree, but it has also restrained to the extent of 263 pounds per acre the rise of available nitrates into a plane above the level of strong root action. The sulphates (expressed as SO_4) accumulated in the surface 3 inches of the firm soil at the rate of 572 pounds per acre, while under the surface maintained loose to a depth of 3 inches the accumulation was only 242 pounds, thus leaving 330 pounds per acre more in the soil moisture of the root zone under the 3-inch cultivation than in the soil moisture where the surface was kept firm. In the case of the phosphates the displacement by capillarity is very much less rapid than in the case of the two salts previously named, the mean accumulation for the six soil types in the surface 3 inches being only 33.42 pounds per acre where the soil was firm, as compared with 20.04 pounds where it was kept loose. The bicarbonates and silicates, or silica, like the phosphates, move relatively much more slowly by capillarity than do the nitrates, sulphates, and chlorids. The relative rates of movement of the bases (potash, lime, and magnesia) under the influence of capillarity are being determined in another series of experiments not yet completed.

FAULTY METHODS OF CULTIVATION.

Some of the methods of cultivation practiced in the South, while effective in killing weeds, are not the best that could be used for the conservation of soil moisture or for controlling the movements of water-soluble salts in the soil, and are often positively harmful to the crops growing upon the ground. One of the methods to which reference is made is the common practice of running the plow close to the row, throwing the earth away from the plants, and leaving the furrows open one or more days. When this practice is followed, if the crop has reached considerable size, with ample leaf surface and strong root development, and if the weather is hot and drying and the soil moisture at all scanty, the crop is quite certain to show the bad effects of this method of cultivation, by the curling of the leaves, as a result of cutting off all roots on the side of the row to the depth the plow has run; and the injury is often so marked and great that it is distinctly recognized that the cultivation must not be done on both sides of the row on the same day. The loose soil thrown into the middle of the row soon loses most of its moisture; the sides of the furrow next to the row and the bottom also dry out very rapidly in the hot sun, so that when the furrow is turned back it is filled with a layer of dry, loose earth, into which new roots must develop to take the place of those cut away; and on top of this layer of dry earth is deposited the moist soil of the second furrow, which in turn loses its moisture rapidly, as does the firm surface of the bottom of the new furrow. It often happens that before new roots have had time to develop into the loose soil formed by the plowing the same operation is repeated on the opposite side, and thus the crop receives a very severe check to its growth by the double root pruning which this form of cultivation effects.

For many crops it is quite certain that the flatter cultivation, instead of the ridge-and-furrow form so much used, would better conserve the moisture and permit the rains to penetrate the soil more quickly and evenly, with less surface drainage and correspondingly less waste of soil fertility. With the distinct ridge-and-furrow cultivation the bad effects of rainfall are intensified if it comes at all rapidly, as then it is quite completely shed into the furrows, where it is forced to cover less than half of the available area of the field, and thus becomes equivalent to a rainfall of more than double the actual amount in its tendency to wash and to float away the organic matter and finer silt, and to dissolve the water-soluble salts of the soil which have accumulated over the whole field by evaporation. The deep, flat cultivation, with many shallow, narrow furrows to draw the water, still leaves ridges, through which the soil air may escape as the water enters by percolation from the bottoms of the furrows, thus facilitating a more

rapid percolation, which thus holds the water at less depth in the furrows, forcing it to flow more slowly and greatly reducing its carrying power, so that washing is less marked.

The flat cultivation practiced in 1903 on corn, potatoes, and cotton worked very satisfactorily, although the rainfall was heavier than in the preceding year. It is true, however, that the fields had been plowed to a depth of 5 or 6 inches with a 14-inch plow, and this undoubtedly gave the soil a higher receiving capacity for rain. The effect of this plowing was to give the entire surface foot a pore space of more than 50 per cent, which means that the surface 6 inches had a pore space of 60 per cent or more; and this again means that in the surface 6 inches alone there was room to store a rainfall of more than 3 inches—a depth of precipitation which does not often occur within a single day. On a soil in such condition, with flat cultivation, the salts which have been drawn to the surface by evaporation drop quickly and evenly back into their proper place, where they become effective in plant feeding, being brought again into contact with the root system, past which they had been carried by capillarity.

GREATER POROSITY AND BETTER GRANULATION FOR SOILS OF SOUTH ATLANTIC AND GULF COASTAL PLAINS.

Over much of the Atlantic coastal plains, and those south of the old glacial borders and back from the Gulf coast east of the Mississippi, there is probably nothing which tends to deplete the cultivated fields of their fertility so rapidly as does surface washing, and how to lessen this or to prevent it altogether is the most serious practical problem of soil management for that whole region. The compact close structure, especially of the surface foot of these soils, their imperfect and feeble granulation, combined with the heavy intermittent character of the rainfall, are the immediate causes of the destructive washing.

In a comparative study of the degree of openness or pore space of some Southern and some Northern soils the following relations were found:

Pore space in some Southern and Northern soils in August and September, 1902.

State.	Number of soil types.	Pore space in percentage of volume.			
		First foot.	Second foot.	Third foot.	Fourth foot.
Georgia	2	44.36	48.82	32.14	31.34
South Carolina	5	48.16	49.88	46.28	38.76
North Carolina	10	46.50	43.12	41.30	39.47
Pennsylvania	8	54.08	46.98	42.30	40.40
Wisconsin	8	54.40	53.49	51.43	47.54

These results are computed from the observed water-free dry weights of these soils per cubic foot, assuming a mean specific gravity of 2.65 for the ingredients of all. It will be seen that the openness of these

soils decreases generally with the depth, and that it is notably largest in the Wisconsin and Pennsylvania soils, and larger in the Wisconsin soils than in those of Pennsylvania.

This openness of structure in soils is an extremely important character, for it determines not only their capacities for both air and water, but also the freedom and rapidity with which these indispensable component parts of all fertile soils move into and out of the root zone. It even determines, in a very large measure, the depth of the root zone itself, and thus the magnitude of the feeding area available to the crops, which in turn is a prime factor in determining the fertility of all field soils. Openness of soil structure and freedom of air circulation through the soil are recognized by all practical greenhouse men as indispensable prerequisites to successful results under their conditions.

Not only do the soils of the North and South differ in their openness of structure, but the soils of the South have a less complete and less strong granulation, and these two characteristics are extremely important in determining not only the freedom with which both rain and air enter and leave the root zone, but at the same time they influence the depth to which roots penetrate the soil. The larger pore space and coarser and stronger granulation provide greater capacity and better facility for the storing of the rain as rapidly as it falls, and as a consequence of this difference in the character of the soils in the two contrasted regions there is better underdrainage, less surface washing of fields, and less loss of water-soluble plant food in the North, while the roots of crops generally penetrate the soils much more deeply than they do in the South.

Whenever heavy rains fall on the Southern soils under consideration, their close structure and feeble granulation result in the surface pores of the soil becoming so quickly and extensively closed that the soil air finds little opportunity to escape, and yet only so fast as it does can the rain enter the soil, and hence during heavy rains the water accumulates quickly and extensively upon the surface. The result is that the surface soil, after having lost much of its coarser granulation, is readily taken up by the water held at the surface, and its finer and more valuable portions, together with the readily water-soluble plant food and organic matter, are borne away in the surface drainage to the great detriment of the fields, giving the muddy, turbid waters so characteristic of Southern streams.

What then shall be done to establish a deeper openness and a coarser and stronger granulation in the soils of the South Atlantic and Gulf coastal plains in order that there shall be lost in the surface drainage less of the most valuable portions of the surface soil, less of the undecomposed organic matter, and less of the readily water-soluble plant food which collects upon the immediate surface through rapid evaporation aided by capillarity?

MORE FREQUENT AND DEEPER PLOWING NEEDED.

There can be little doubt that deeper plowing will not only lessen the tendency of Southern soils to wash, but that it will increase their general productive capacity. The deeper general plowing at frequent intervals, quite likely as often as once a year, will not only increase the effective openness of the soil, but it will greatly aid in developing a stronger and better granulation, and both conditions are necessary to reduce the tendency to wash. In our comparative studies this year on eight types of soil, the plowing to depths of 5 to 7 inches to which they were subjected had the effect of giving to the surface foot of the soil types in the respective regions the values indicated in the following table:

Mean water-free dry weights per cubic foot of eight soil types at three dates during the growing season after plowing.

Locality and soil type.	Date of sampling.		
	April 29.	June 22.	August 24.
	Pounds.	*Pounds.*	*Pounds.*
Goldsboro, N. C.:			
Norfolk sandy soil	71.99	86.83	86.64
Selma silt loam	68.57	80.40	80.97
Upper Marlboro, Md.:			
Norfolk sand	83.76	85.09	85.88
Sassafras sandy loam	77.39	75.68	81.36
Lancaster, Pa.:			
Hagerstown clay loam	55.75	68.46	70.86
Hagerstown loam	61.51	73.52	76.56
Janesville, Wis.:			
Janesville loam	58.17	69.63	71.55
Miami loam	62.81	79.17	77.84

Although the first sets of samples were taken after the firming due to harrowing and smoothing, the table shows that the plowing did develop a notable increase in the openness of all the soils except those of Upper Marlboro, Md., and that this increase of openness had not entirely disappeared at the end of August, and yet the rainfall during the period was more than usually heavy, being 19.44 inches at Goldsboro, 19.78 inches at Upper Marlboro, 18.87 inches at Lancaster, and 18.75 inches at Janesville. The changes in weight per cubic foot which took place after plowing these soils indicate that the most fundamental difference in their structures is that due to differences in granulation, for all of the soils which have changed in weight markedly have changed to about the same extent, most likely due to the reduction of open spaces in the soils outside of the granulation.

But the most important object to be gained by plowing Southern soils deeper than is generally practiced is that of turning under the roughage of the fields and other organic matter more deeply, where it may be less rapidly decomposed and where it may become more effective in bringing about that better granulation of the soils essential to the best tilth.

IMPORTANCE OF THE GRANULAR STRUCTURE IN SOILS.

The granular condition is the most important physical difference between an agricultural soil and a clay. It is the one which the potter tries to obliterate from his stock, because it renders his wares too weak and open, and it is the condition which by soil management we should strive to intensify and maintain to a high degree in most soils.

When all soil particles are very small and separate, the passageways for air and water are so fine and the resistance to flow so great as to make the circulation too slow to meet the demands of crops; but when the fine particles are massed together into granules, giving to the body of the soil openings of the order found in sandy soils, we have that freedom to motion of air, moisture, and soil particles which constitutes the essential characteristic of a soil in good tilth. The soil then has the desirable openness, so far as wide passageways are concerned, which is the recognized valuable feature of a sandy soil. In addition to this, its granules possess a sponge-like quality which enables them to absorb moisture and to concentrate within themselves the water-soluble plant foods, thus greatly lessening the danger of their being leached away and permitting them to enter the root hairs of crops whenever the latter lay themselves closely upon the surfaces of the granules, as is their habit.

In consequence of this structural character of clay soils in the best of tilth, they possess a storage capacity for available plant foods, which the sands and imperfectly granulated soils never have, and when plant foods are added to them they are able to receive and retain them in larger amounts than can the sandy soils.

In an experiment where a solution containing known amounts of plant food was caused to percolate three times in quick succession through a layer of each of eight soils, these soils retained within themselves the following amounts of the different ingredients:

Plant food taken from a solution by eight soil types after percolation through soil three times.

[In parts per million of dry soil.]

Soil type.	Salts retained.					
	K.	Ca.	Mg.	NO_3.	HPO_4.	SO_4.
Southern soils:						
Norfolk sandy soil, North Carolina	330	680	259	420	79	875
Selma silt loam, North Carolina	280	675	203	135	101	1,875
Norfolk sand, Maryland	265	650	141	330	110	1,125
Sassafras sandy loam, Maryland	280	650	132	240	215	125
Northern soils:						
Hagerstown clay loam, Pennsylvania	575	700	133	240	133	1,250
Hagerstown loam, Pennsylvania	410	650	141	235	149	2,375
Janesville loam, Wisconsin	652	575	294	285	63	375
Miami loam, Wisconsin	602	600	203	215	111	250

The solution used with these soils contained calcium phosphate ($CaHPO_4$), magnesium sulphate, calcium nitrate, and potassium sulphate in such proportions as to represent 300, 340, 300, 470, 100, and 1,600 parts per million of the solution of K, Ca, Mg, NO_3, HPO_4, and SO_4, respectively, and the amounts of solution passing through the soils were five times the dry weights of the soils. The layers of soils were three-sixteenths of an inch thick, and the solution was in contact with the soil grains in the aggregate less than forty-five minutes.

From these same samples of soils before this solution percolated through them there were recovered, by repeated percolation of distilled water through them in charges equal to five times their dry weights, the following amounts of the same ingredients:

Amounts of water-soluble salts recovered from eight soil types by percolating through eleven charges of distilled water, each equal to five times the dry weights of the soils.

[In parts per million of dry soil.]

Soil type.	Salts recovered.							
	K.	Ca.	Mg.	NO_3.	HPO_4.	SO_4.	HCO_3.	SiO_2.
Southern soils:								
Norfolk sandy soil, North Carolina	128.6	87.9	77.4	42.1	25.6	441.0	12.0	65.7
Selma silt loam, North Carolina	191.6	258.5	35.3	69.1	41.9	770.0	70.0	69.7
Norfolk sand, Maryland	167.5	247.8	92.2	45.5	35.3	793.5	104.0	79.0
Sassafras sandy loam, Maryland	173.9	369.8	96.4	78.7	34.8	848.0	88.0	94.1
Northern soils:								
Hagerstown clay loam, Pennsylvania	191.9	794.3	334.2	151.8	70.6	1,608.0	358.0	150.6
Hagerstown loam, Pennsylvania	221.2	722.0	329.7	123.0	56.2	1,779.0	316.0	148.3
Janesville loam, Wisconsin	273.4	837.5	271.8	120.1	226.4	1,816.0	180.0	198.0
Miami loam, Wisconsin	216.0	708.0	239.1	170.3	174.5	1,501.5	220.0	222.1

It has not yet been demonstrated in what manner these salts are retained about and within the soil granules, but the indications point strongly to the conclusion that they are in part at least held physically concentrated in the soil moisture about and within the soil granules.

If the water-soluble plant food is concentrated within the soil granules, as many lines of observation followed out appear to indicate, it is easy to understand how there is less leaching from the soils belonging to the highly granulated types than there is from the sandy soils. Indeed, when we have percolated solutions through clean white sand, freed from all silt, so that there was nothing fine enough to permit of flocculation, the amounts, even of potash and phosphoric acid, retained have been so small as to be almost within the limits of the errors of observation. But whatever the explanation may be, the

facts remain that soils may be made to take large amounts of salts from a solution percolating through them, and that equally large amounts may be recovered again from them by repeated washing in distilled water; and from such observations it appears more than probable that the salts so retained are available to the crop which spreads its root hairs over the surfaces of the soil grains and soil granules.

CONDITIONS WHICH FAVOR DEVELOPMENT AND MAINTENANCE OF GRANULAR STRUCTURE IN SOILS.

No soil is completely and strongly granulated to the extent of agricultural service unless it is well drained, at least periodically; and a soil which has once been well granulated, if kept long and continuously filled with water, will in time lose much of its former structure. But when drainage is ample, so that air as well as water occupies the spaces between the soil grains, the surface tension of the water, as the drought condition approaches, acts to bunch the finer particles about and between the larger ones, giving the granular structure.

As the dissolved salts accumulate about and within these granules, after sufficient concentration has taken place they may be deposited and become a cementing medium, giving the soil granules the varying degrees of stability which enable them to resist tendencies to break them down.

A crop which has an extensive and finely divided root system, like that of bluegrass or timothy, greatly assists in the granulation of soils by establishing parting planes between soil masses, and, in intensifying the drying of the soils, brings it oftener into the condition which favors the bunching of the soil particles.

One of the most important effects of stable manure when applied to soils is its tendency to establish parting planes in the soil which favor both the formation and maintenance of strong granulation. Green manures, too, well plowed under and allowed to decay, exert a physical effect upon soil granulation analogous to that of roots and of stable manure, although their action is relatively not as strong.

NEED OF INCREASING THE ORGANIC MATTER IN SOUTHERN SOILS.

Very many of the soil areas of the South, on account of both natural conditions and the long and almost universal practice of using but little stable manure and of neglecting to plow under in any thorough and persistent manner the roughage which is left upon the fields, are low in that form of organic matter which can to any notable extent influence soil granulation. Further than this, the shallow rooting of the crops, and the rough, ridged, and extreme surface exposure of the soils which the methods of tillage generally in vogue establish, all

conspire to hasten the complete oxidation of the small amounts of organic matter the surface soil chances to acquire, and thus to maintain a low humus content which at once determines a poor soil texture, a low rate of nitrification, a low content of most water-soluble salts, and, therefore, a low crop-feeding capacity.

In the management of soils under any climatic conditions too much emphasis can hardly be laid upon the importance of maintaining a sufficiently high content of organic matter in the soil; for the observations made in the Bureau of Soils appear to point clearly and strongly to a rise and fall of the water-soluble salts in soils with the amounts of water-soluble organic matter which can be recovered from them, and there appears to be more than an accidental relation between them aside from the nitrates.

That there is a clear and strong difference between the four Southern and the four Northern soils studied, in the water-soluble salts which may be recovered from them by washing in distilled water, is shown in one of the tables already given (p. 167). It is clearly shown, also, in the table which follows, which is made up of averages of three sets of determinations on the surface 4 feet, made at the beginning, at the middle, and near the close of the crop season:

Water-soluble salts recoverable from surface 4 feet of eight soils by washing once during three minutes in distilled water, and given as mean sums from the 4 feet.

[In parts per million of dry soil.]

Soil type.	Salts recovered.					
	K.	Ca.	Mg.	NO_3.	HPO_4.	SO_4.
Southern soils:						
Norfolk sandy soil, North Carolina	47.5	91.6	44.7	36.7	32.0	186.9
Selma silt loam, North Carolina	42.7	114.9	45.1	26.8	33.3	215.8
Norfolk sand, Maryland	46.5	94.5	42.2	35.9	46.8	150.5
Sassafras sandy loam, Maryland	47.1	100.8	47.5	34.3	36.5	249.4
Northern soils:						
Hagerstown clay loam, Pennsylvania	48.9	264.4	78.0	66.8	56.3	364.8
Hagerstown loam, Pennsylvania	60.4	233.4	69.1	105.3	48.1	314.7
Janesville loam, Wisconsin	100.0	293.6	115.2	153.7	92.2	653.6
Miami loam, Wisconsin	68.0	277.7	102.1	52.8	76.1	549.4

Differences in yield of corn and potatoes resulted from these eight soils where they were treated in every way alike, showing the same order of similar relations.

There can be no question but that generally throughout the cotton belt of the South, where cotton will continue to be the staple crop, a system of stock raising might be added as an adjunct, which, together with a proper rotation of crops, could be made to yield net returns enough to more than cover the enormous fertilizer bills of the South, and in addition thereto to place the aggregate yield of cotton far above

what it now is. Much, of course, may be done with the use of commercial fertilizers in conjunction with green manuring and proper rotations, but this can not approach in real value, everything considered, what may be made to follow a rational introduction of live stock as an adjunct to the present cultural methods for improving and maintaining soil fertility.

RELATIVE RATES OF NITRIFICATION IN SOME SOUTHERN SOILS.

Since the immediate source of nitrogen for all green plants is the nitric acid or nitrates carried in the soil moisture, and since the amounts present in a soil may vary rapidly with changing conditions, the effective fertility of a soil at any time is influenced strongly by the rate of nitrification possible in the soil under the conditions which surround the growing crop.

In one series of comparative studies made on the eight soil types investigated during the season of 1903, all of the soils were given their optimum amounts of moisture and were then placed under like favorable conditions for nitrification, except that no attempt was made to inoculate them with the nitrifying organisms, as the prime object was to measure the rates of nitrification under the existing conditions. The amounts of nitrates (NO_3) present in the several soils at the close of a period of seventy days are given in the following table, together with the amounts present at the start and the changes which had taken place:

Nitrates, expressed as NO_3, in the surface foot of eight soil types at close of seventy days.

[In parts per million of dry soil.]

Periods of experiment.	Goldsboro, N. C.		Upper Marlboro, Md.		Lancaster, Pa.		Janesville, Wis.	
	Norfolk sandy soil.	Selma silt loam.	Norfolk sand.	Sassafras sandy loam.	Hagerstown clay loam.	Hagerstown loam.	Janesville loam.	Miami loam.
After seventy days	70.00	88.60	71.40	121.00	168.8	161.8	177.2	142.8
At start	33.04	48.40	24.20	39.28	64.9	56.8	121.0	51.9
Change	36.96	40.20	47.20	81.72	103.9	105.0	56.2	90.9

The amounts of nitrates recoverable after seventy days by the three-minute washing to which these soils were subjected were at the rates of 265, 310, 267, 399, 503, 518, 537, and 492 pounds per acre, computed upon the observed dry weights of soil in the surface foot of each soil type, and given in the order of the above table.

INFLUENCE OF LIME AND STABLE MANURE ON NITRIFICATION AND WATER-SOLUBLE PHOSPHATES AND SULPHATES.

In these experiments composite samples of the surface foot of soil of each type were procured, and after mixing and bringing them to

good moisture condition each sample was divided into four lots of 15 pounds each, to one of which nothing was added, to another lime at the rate of 1 ton per acre, to another 10 tons of air-dry stable manure per acre, and to the fourth 10 tons of air-dry manure and 1 ton of lime per acre. The soils were kept at nearly constant moisture and good aeration conditions during a period of about fifty days, at the end of which time the soluble salts were determined, with the results given in the following table:

Changes in the amounts of nitrates, expressed as NO_3, after fifty days.

[In parts per million of dry soil.]

Periods of experiment.	Type of soil.					
	Sand-hill.	Selma silt loam.	Norfolk sand.	Goldsboro compact sandy loam.	Norfolk fine sandy loam.	Pocoson.
Where nothing was added to soil:						
Found at close	17.10	136.5	117.0	71.5	92.0	198.0
Present at start	3.76	42.2	19.9	19.3	15.7	41.6
Amount produced	13.34	94.3	97.1	52.2	76.3	156.4
Where lime alone was added at the rate of 1 ton per acre:						
Found at close	99.20	150.0	132.0	84.0	105.6	205.0
Present at start	3.76	42.2	19.9	19.3	15.7	41.6
Amount produced	95.44	107.8	112.1	64.7	89.9	163.4
Where manure alone was added at the rate of 10 tons, air dry, per acre:						
Found at close	80.00	193.0	166.0	104.0	114.4	213.0
Present at start	3.76	42.2	19.9	19.3	15.7	41.6
Amount produced	76.24	150.8	146.1	84.7	99.7	171.4
Where both lime and manure were added at rates of 1 and 10 tons per acre, respectively:						
Found at close	124.00	220.0	181.0	116.0	132.0	231.5
Present at start	3.76	42.2	19.9	19.3	15.7	41.6
Amount produced	120.24	177.8	161.1	96.7	116.3	189.9

From this table it will be seen that in the extremely sandy type of soil the addition of lime alone allowed the rate of nitrification to exceed that which occurred in two of the other types to which only lime was added, and also that the lime materially increased the rate of nitrification in them all. The increase during the fifty days over that present in the soil at the start for the six types was enough to amount to 286, 323, 336, 194, 269, and 490 pounds per acre in the surface foot, taking the mean weight of soil at 3,000,000 pounds, and stating the amounts in the order in which the soils are named in the table. It is noteworthy, too, that the lime alone had a greater influence in stimulating

nitrification on the Sandhill type than did the 10 tons of stable manure alone, while in the case of the Pocoson neither the lime nor the manure alone, nor the two combined, stimulated the rate of nitrification in as marked a way when compared with the rate which was maintained in the same untreated soil, which, however, was far higher than that in any other case. In other words, the untreated Pocoson soil was nearly in prime condition for nitrification, so that the combined effect of the manure and lime increased the nitrates (NO_3) produced at the rate of only 101 pounds per acre in the fifty days.

The changes which occurred in the amounts of sulphates (SO_4) recoverable by washing three minutes in distilled water were also marked, and are given in the following table:

Amounts of sulphates, expressed as SO_4, recoverable after about fifty days.

[In parts per million of dry soil.]

Periods of experiment.	Type of soil.					
	Sandhill.	Selma silt loam.	Norfolk sand.	Goldsboro compact sandy loam.	Norfolk fine sandy loam.	Pocoson.
Where nothing was added to soil:						
Found at close	3.1	60.1	29.5	59.8	53.0	28.1
Present at start	3.1	43.7	20.8	33.0	16.1	13.2
Change	0.0	16.4	8.7	26.8	36.9	14.9
Where lime was added at the rate of 1 ton per acre:						
Found at close	9.2	83.2	48.4	80.9	65.3	36.2
Present at start	3.1	43.7	20.8	33.0	16.1	13.2
Change	6.1	39.5	27.6	54.1	49.2	23.0
Where manure was added at the rate of 10 tons, air dry, per acre:						
Found at close	5.1	78.6	54.8	70.4	80.0	38.2
Present at start	3.1	43.7	20.8	33.0	16.1	13.2
Change	2.0	34.9	34.0	37.4	63.9	25.0
Where both lime and manure were added at the rates of 1 and 10 tons per acre, respectively:						
Found at close	11.4	101.7	59.0	93.6	95.2	47.2
Present at start	3.1	43.7	20.8	33.0	16.1	13.2
Change	8.3	58.0	38.2	60.6	79.1	34.0

From this table it is clear that associated with the nitrification there has been a liberation of sulphates, apparently more from the materials of the original soils than from the materials added, and in larger amounts where the lime and manure are added together.

The changes in the amounts of phosphates have all been in the opposite direction from those of either the nitrates or the sulphates, shown in the following table:

Changes in amounts of water-soluble phosphates, expressed as HPO_4, after fifty days.

[In parts per million of dry soil.]

Periods of experiment.	Type of soil.					
	Sand-hill.	Selma silt loam.	Norfolk sand.	Goldsboro compact sandy loam.	Norfolk fine sandy loam.	Pocoson.
Where nothing was added to soil:						
Found at close	1.46	2.46	1.49	3.78	2.30	2.39
Present at start	6.90	14.20	11.50	7.20	8.12	18.00
Change	5.44	11.74	10.01	3.42	5.82	15.61
Where lime was added at the rate of 1 ton per acre:						
Found at close	1.46	3.28	2.99	3.78	2.30	3.19
Present at start	6.90	14.20	11.50	7.20	8.12	18.00
Change	5.44	10.92	8.51	3.42	5.82	14.81
Where manure was added at the rate of 10 tons, air dry, per acre:						
Found at close	2.18	4.92	3.74	4.54	4.22	3.99
Present at start	6.90	14.20	11.50	7.20	8.12	18.00
Change	4.72	9.28	7.76	2.66	3.90	14.01
Where both lime and manure were added at the rates of 1 and 10 tons per acre, respectively:						
Found at close	3.28	6.18	4.48	4.54	3.83	4.79
Present at start	6.90	14.20	11.50	7.20	8.12	18.00
Change	3.62	8.02	7.02	2.66	4.29	13.21

Associated with the increased amounts of nitrates and sulphates and of other water-soluble salts and with the changed physical and other conditions which favored the increased rates of nitrification, there were other changes occurring which placed the phosphates in conditions preventing their recovery from the soils by single three-minute washings in distilled water in as large amounts as were recovered from the same soils immediately prior to their being placed in the nitrification experiment. The soils were under quite different physical conditions, so far as soil moisture and soil air were concerned, but how far these may have determined the changes referred to can not yet be stated; but what seem to be comparatively slight physical differences are undoubtedly responsible directly or indirectly for very different results in the amounts of water-soluble salts recoverable from different soils. The truth of this statement will be clear from a comparison of the amounts of nitrates in the different layers of the six

soils under consideration after they had stood under the mulched and unmulched conditions where all other conditions were the same so far as we know, except in so far as the condition of the two surfaces affected the soil moisture and soil air relations, and through those the differences in the amounts of water-soluble salts recoverable by our methods of washing. The table following shows the differences developed at different depths below the depth of the 3-inch mulch and below 3 inches in the soil not mulched:

Differences in the amounts of nitrates, expressed as NO_3, in six soil types at different depths below surface under 3-inch mulches and where surface was firm.

[In parts per million of dry soil.]

Depth below surface.	Type of soil.											
	Sandhill.		Selma silt loam.		Norfolk sand.		Goldsboro compact sandy loam.		Norfolk fine sandy loam.		Pocoson.	
	Mulched.	Unmulched.	Mulched.	Unmulched.	Mulched.	Unmulched.	Mulched.	Unmulched.	Mulched.	Unmulched.	Mulched.	Unmulched.
3 to 6 inches	4.0	4.6	98.0	26.8	52.8	9.1	46.8	8.2	25.0	12.3	91.2	33.2
6 to 9 inches	6.2	4.5	52.4	28.1	46.8	11.5	35.8	7.0	25.3	11.0	78.1	26.4
9 to 12 inches	3.8	4.7	52.9	24.6	13.9	9.3	30.6	5.7	16.1	9.1	52.0	27.2
12 to 15 inches	3.9	2.6	32.5	20.5	16.9	7.3	27.2	4.8	16.2	7.9	26.5	19.6
15 to 18 inches	1.9	2.3	20.4	15.2	3.1	7.8	7.0	2.8	7.8	5.7	13.7	10.7

It will be seen that we have, in every one of the six soil types, profound differences in their nitrate content at the several depths below the surface, which not only emphasize the point under consideration but also the influence of tillage on the water-soluble content of the soil already referred to. The larger amounts of nitrates shown here under the mulched surfaces are not due simply to the fact that less has been carried above the 3-inch layer, where the soils were mulched, for the total amounts recoverable from the full 18 inches were larger. The figures in the table show in an emphatic manner how influential the 3-inch mulch had been in holding the nitrates in the zone of greatest root development, where they are needed and can best be obtained by the plants.

THE CULTIVATION OF CORN.

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GENERAL REMARKS.

The object of this article, like that in the Yearbook[a] for 1902, is to present to farmers some suggestions as to the surest and quickest means of increasing the production of corn per acre. The writer feels certain that it is possible within a few years to double the average production of corn per acre in the United States, and to accomplish it without any increase in work or expense. It is not to be understood from this that it is desirable to double the present corn crop, but that it is desirable to produce the same yield on a smaller number of acres and with less labor. If 60 bushels are raised on 1 acre instead of on 2 acres, the labor of plowing, harrowing, planting, cultivating, and harvesting is greatly reduced. Some farmers produce from year to year an average of more than 60 bushels per acre, but the average of the entire United States for the past ten years (23½ bushels per acre) shows that many are annually harvesting less than half of this quantity. Since the average crop in the States best adapted to corn growing is but little above the general average of the entire country, it is evident that the average is not lowered to any great extent by the poor crops in sections unsuited to corn growing. Moreover, the yield per acre in the New England States, with their poor soil and short growing season, is greater than in any other part of the country. This clearly indicates the possibility of greatly increasing the yield per acre in the corn belt. This is especially easy of accomplishment in the Southern States, where the present average is low and where the growing season is not shortened by frosts.

Practical corn growers will understand the impossibility of giving specific directions regarding the best methods of planting and cultivating corn that would be applicable to any considerable portion of the United States. The soil or drainage of different farms is often so different as to demand different methods of culture. It is therefore only possible in a general article of this kind to tell what methods have been successful in some sections of the country and to discuss the

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[a] "Improvement of corn by seed selection," by C. P. Hartley, Yearbook of the U. S. Department of Agriculture, 1902, pp. 539–552.

general effects on the soil and crop of certain methods of plowing and cultivating, leaving it to the judgment of the grower to decide upon the best methods for his particular soil and climate.

The most valuable information regarding the growing of corn in any particular section can be obtained from unprejudiced observant corn growers of many years' experience; and the writer wishes to thank the hundreds who have so kindly given him such information. The fact that the experiences of growers in different localities and the reports of experiments from the various State experiment stations do not agree should not lower the estimation of the value of either. Such disagreement follows necessarily from the different soils, altitudes, latitudes, and seasons. Conflicting published statements have caused some to cease trying to learn better methods from the experiences of others, but a study of the conditions will show good reasons for the conflicting results reported.

The methods of cultivation in general use in one section of the country differ greatly from those in another section. The implements and methods employed in Iowa are as different from those of Connecticut as these in turn are different from those of Georgia; and while these differences are to some extent due to the nature of the farm land or to the class of labor employed, they are to a still greater extent due to the conservatism of the farmers themselves. That certain kinds of cultivators or plows or methods of planting have been in use in Georgia or Iowa for many years does not prove that implements or methods found successful in other States might not be used there to advantage. It is much too common for the majority of growers in a locality to adhere to methods accepted as best simply because they have been followed for years. They often purchase a particular kind of plow, corn planter, or cultivator because it is the one in general use or the only kind for sale by the local implement dealer, without considering whether some other kind might not be better suited to their farms. Merchants and manufacturers are so familiar with the methods or machinery of their competitors that any time or labor saving system or device adopted by one soon comes into general use. A similar diligence and enterprise should be exercised by farmers. If every corn grower could visit all the corn-producing States of the Union, the general result would be the discarding of poor and the adopting of improved methods. No section excels in all respects, but almost every section excels in some respect.

In the South Atlantic States the observant corn grower would notice the use of terraces for preventing the washing away of the top soil (Pl. XI, figs. 1 and 2). He would also see the advantage of spacing rows and stalks in the rows at distances suited to the fertility of the soil; and, where poor soil necessitates the planting of the rows 6 feet apart, he would perceive the economy of growing a soil-enriching,

FIG. 1.—SOIL WASHING PREVENTED BY TERRACES.

FIG. 2.—COTTON AND CORN GROWING ON A WELL-TERRACED FARM IN ALABAMA.

FIG. 3.—WIDE PLANTING, WITH PINDARS BETWEEN THE CORN ROWS.

FIG 1.—SOIL TOO POOR FOR PROFITABLE CORN GROWING.

FIG. 2.—AVERAGE PRODUCTION REDUCED BY INFERTILE SPOTS.

FIG. 3.—AVERAGE PRODUCTION REDUCED BY UNDRAINED SPOTS.

leguminous plant between the corn rows (Pl. XI, fig. 3). On the broad prairies of the Western States he would learn methods of curtailing expenses by the use of plows, planters, cultivators, and corn harvesters designed so that one man can work a large number of horses and thereby accomplish a maximum of work. With such implements one man can, without help, plant and care for 40 or 60 acres of corn in addition to his other crops. The same methods and implements are suitable for many farms where more tedious and laborious methods are now followed.

SOME LAND TOO POOR FOR PROFITABLE CORN GROWING.

While it is true that proper attention to seed selection and methods of cultivation will greatly increase the average production per acre for all land now devoted to corn growing, it is equally true that the cultivation of corn will never be found profitable on very poor land. Some growers, from force of habit, perhaps, every spring plant corn on land which they know is too poor to produce a profitable crop (Pl. XII, fig. 1). The plowing and cultivating of poor soil is as expensive as the plowing and cultivating of fertile soil. Corn growing should not be attempted on such land until it is brought into a fertile condition by the growing and plowing under of leguminous crops, the application of manures, etc. In the meantime some of the crops that require less fertility than corn may be grown. It should be remembered that the nature of the corn plant is such that it will not produce grain unless the soil is rich enough to afford a considerable growth of stalk, and that the best yield of ears is not obtained unless the stalks have made a maximum growth. For this reason some other plants will produce small or fair crops on soil too poor to produce corn. A cotton plant adjusts its yield of lint to the fertility of the soil, a small plant producing a small number of bolls containing lint of as good a quality as that from a larger plant bearing many more bolls. A hay crop is also in quite regular proportion to the fertility of the soil. *This is not true, however, of corn.* When poor soil dwarfs grass to half its normal size, the crop of hay is reduced by about one-half, but when poor soil dwarfs the corn plants to half their normal size it is probable that there will be little or no grain yield, and any ears that are produced will be small and inferior.

Even in the best corn-producing States there is some land so poor that farmers who persist in attempts to grow corn on it receive nothing for their labor. Such land, however, in a few years' time can be made to produce good corn crops. The growers who are quickest to learn the futility of attempting to grow corn on impoverished land are those whose farms contain some poor upland fields and some fertile bottom land. They find it necessary to fertilize and renovate the poor fields

or confine corn growing to the bottoms. In most regions creek bottoms and river valleys are particularly adapted to corn growing, as they usually have a fertile soil and a subsoil well supplied with moisture.

Another explanation of the low yield per acre on many farms is the amount of unsuited or unimproved areas frequently embraced within the boundaries of fields planted to corn. In many cornfields throughout the country may be seen portions or spots on which it is impossible for corn to thrive. These may be clayey spots (Pl. XII, fig. 2), or swampy or undrained areas (Pl. XII, fig. 3), or ground adjacent to timber (Pl. XIII, fig. 1). It is too great a waste of labor to plow, harrow, and cultivate such unproductive spots. They should be improved so that they will yield a profit, or they should not be planted at all. The poor clay spots should be enriched, the swampy places drained or filled, and the corn should be planted farther from the timber, with a strip of timber grass next to the trees. Many farms could be made more profitable by rearranging the fields in order to make them more uniform as regards moisture and soil fertility, so that the entire field may be treated as the character of the soil may demand. No field can be well tended if the corn rows extend through a portion too wet for cultivation when another portion is in best condition for cultivation.

MEANS OF PREVENTING SOIL WASHING.

More land has been rendered unfit for corn growing by the washing away of the surface soil than by constant cropping. Soil washing must be guarded against if profitable crops are to be harvested from the same field for a number of years, and with proper attention in this respect the farm will become better from year to year. The effect of heavy rains is to wash out gullies and ditches and to carry away the soil and plant food as muddy water. If this is allowed to continue unchecked the fertility is reduced, the soil itself is carried away, and the land becomes less productive from year to year. One heavy rain will sometimes carry away from a field more soil than a man with a team and wagon could restore in a week. It is to be regretted that farmers in the newer and more fertile sections of the country are not as wide-awake to the destructive effects of soil washing as they are in older sections, where the farms have already been injured by the rains of past centuries, and where constant attention is now necessary to retain the fertility which is at some expense put into the soil.

ROLLING OR HILLY LAND.

It should not be supposed that because land is rolling or hilly washing must take place. Some very hilly sections which have deep, porous soils, full of humus, wash but little, and that only when the ground is

frozen to a considerable depth and thaws on the surface. Hard soils that do not readily take up the water that falls upon them wash much more than loose, porous soils. The most effective means of preventing washing is to cover the soil with vegetation and loosen the subsoil so that the rainfall can penetrate and be absorbed instead of running off. The rows of corn, moreover, should run at right angles to the direction of the slope. Terraces are also effective barriers to soil washing, and their use is to be encouraged. These methods could be profitably employed on the sloping lands near the Ohio and Mississippi rivers. It is the desire of most farmers to have straight corn rows, and on level land this is preferable, but on hills better success will be obtained by running the rows at the same level around the hills. This will necessitate curved rows, but the curves will usually not be abrupt enough to make cultivation difficult; in fact, cultivation is thus rendered much easier, since it is not necessary to plow up and down the hill, which, to prevent soil washing, should always be avoided.

ABSORPTION OF RAINFALL.

The carrying away of soluble plant food and lighter portions of soil is not the only objectionable feature of soil washing. The water itself is likely to be needed during some portion of the summer. By loosening the subsoil and covering the surface with a growth of vegetation, the soil can be made so absorbent that the water will penetrate the ground and be held in reserve to sustain the growing plants during times of drought. It would seem that after a period of heavy rainfall, during which 8 or 10 inches of water fell within a month, the soil and subsoil of all fields would be alike saturated, but such is not the case. The condition of the surface soil has much to do in determining how much of the rainfall will be absorbed. The condition of the subsoil is also important. If its moisture has been exhausted by lack of cultivation and injudicious cropping, it will absorb water more slowly than when it is already moist. Thus it is that the subsoil of some fields remains dry to a depth of several feet during a season of heavy rains, while that of other fields absorbs water in sufficient abundance to sustain crops during periods of drought. To readily absorb the water that falls during times of heavy rains the surface soil must be loose and porous, so as to take up the water rapidly before it has time to accumulate, and hold it thus until by capillary attraction it is drawn to the subsoil.

Some very fine clay subsoils are so compact that they turn water almost as effectually as a slate roof. Such subsoils should be rendered permeable, and the most effective and cheapest way to accomplish this is by growing deep-rooted plants, such as clovers, alfalfa, melilotus, etc. The roots of these plants penetrate the subsoil and, decaying, leave numerous ducts through which water from the surface soil will

pass to greater depths. That this is exactly what occurs is proved by comparisons of plats of ground on which such plants have been grown with adjacent plats on which they have not been grown. The former plats are firm soon after heavy rains, because the water has found its way into the subsoil, while the latter plats remain muddy on the surface. Some subsoils are the reverse of those just referred to; instead of being too compact they are too open. A subsoil of coarse gravel may allow the water to pass through too readily, thus washing out and draining away the fertility. Such subsoils are not compact enough to supply the surface soil with moisture by capillary attraction. Soils of this nature are greatly benefited by the plowing under of vegetable matter, which, besides adding greatly to the soil fertility, checks the rapid leaching through the subsoil and enables it to retain moisture better during dry weather. The application of vegetable matter improves the fertility and physical condition of almost all soils, regardless of whether the subsoil is compact or porous.

IMPORTANCE OF RETAINING SOIL MOISTURE.

The amount of moisture needed to produce a crop is much greater than would be imagined. In the case of corn, it is sufficient to cover the field with water to a depth of from 10 to 15 inches.[a] About three-fifths of this quantity, or from 6 to 9 acre-inches of water, is absorbed by the roots and exhaled by the foliage of the growing crop.[b] More corn crops are cut short by an insufficient quantity of available soil moisture than by any other cause. This is well demonstrated by the fact that fields situated by rivers or lakes in such a manner that the subsoil always contains sufficient moisture seldom fail to produce good corn crops. The greater portion of the corn-growing area, however, is dependent directly upon the rainfall for its water supply, and it is for this reason that this matter is here considered so important.

After the soil and subsoil have become well supplied with moisture by the rains of fall, winter, and spring, the next important consideration is the means by which it can be retained in the soil constantly within reach of the growing crop. The effect of sunshine and wind is to cause the moisture to pass rapidly from the soil directly into the atmosphere, and unless cultural methods are employed to lessen evaporation much of the soil moisture will pass into the air without benefiting the crop except in a very slight and indirect way. For the good of the crop as much of the soil moisture as possible should pass into the atmosphere through the plants. In this way it will carry the soluble plant food into the plants, whereas if allowed to evaporate from the surface of

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[a] Ninth Annual Report Wisconsin Agricultural Experiment Station, p. 99.

[b] Experimental Investigations into the Amount of Water Given off by Plants. Rothamsted Memoirs, by Lawes and Gilbert, Vol. I.

the soil it will leave the soluble plant food deposited on or near the surface, where it will be inaccessible to the roots until it is cultivated deeper into the soil or washed there by succeeding rains.

As the moisture from the surface evaporates it is replaced by moisture drawn from greater depths by capillary attraction, just as oil is drawn through the wick of a lamp to replace that which is consumed by the flame. The rapidity with which moisture will evaporate from the ground depends upon the condition of the capillary tubes or pores that connect the surface with the deeper soil. Any dry blanket that can be placed between the atmosphere and the damp soil will check this evaporation. The most practical protection is a covering of finely pulverized dry soil 2 or 3 inches deep. By thoroughly loosening the surface layer, the soil particles are disarranged so that the capillary tubes are not continuous. In this condition the surface soil becomes quite dry and remains so without absorbing moisture from below, thus acting as a mulch and retaining the moisture within reach of the plant roots. It is necessary that this soil mulch be fine, for, if composed of clods, air circulates between them and causes evaporation to take place from the soil below the surface. A rain, however, will wet the surface, causing the soil to run together and crust, thus restoring capillarity. This makes another cultivation necessary in order to renew the blanket of fine, loose soil.

FERTILIZERS AND CROP ROTATION.

The question of the chemical fertilizers best suited to the corn plant is too broad for discussion within the limits of this article. The corn plant needs plenty of food and for most profitable results should be grown on fertile soil. A soil lacking in plant food can, of course, be made to produce a crop of corn if the requisite amounts of nitrogen, phosphate, potash, and other essential elements be added and the soil kept in a good physical condition; but the growing of corn on very poor land is usually attended with very little or no profit, and the application of commercial fertilizers does not permanently improve the soil. It is usually preferable to spend a given sum of money in buying corn rather than to make the same outlay for fertilizers in order to raise the crop on impoverished soil. If the soil is of such a nature that the application of one or a few elements at a small cost will cause it to produce good corn crops, these elements should be supplied; but if the soil is little more than a foundation, to which must be added a large portion of the necessary plant food, corn growing should be suspended until the soil is permanently enriched by applying large quantities of barnyard manure or by liberal and continued growing and plowing under of leguminous crops rich in nitrogen.

Nitrogen, which is an essential element of plant growth and the most costly ingredient of chemical fertilizers, in a free state constitutes

four-fifths of the atmosphere. By the aid of microscopic organisms[a] leguminous plants, such as clovers, vetches, beans, peas, and the like, extract nitrogen from the atmosphere and store it in the soil in a form available to succeeding crops. This is one of nature's ways of applying fertilizer, and by working in harmony with nature man can hasten these processes and render poor soils fertile in a few years' time and at but slight expense other than for labor. Soils enriched by the growing and plowing under of leguminous plants retain their fertility well, but no soil, unless it be a river bottom which is frequently renewed by overflows, should be planted to corn year after year. The fertility should be maintained and improved by crop rotation and by the turning under of green crops, which can often be grown the same season with the crop grown for profit.

In sections where wheat, oats, or other crops are harvested in early summer, it is almost always desirable to follow them with a soil-improving crop that can be turned under that fall or the following spring. Clover sod, turned under in the autumn and then torn to pieces and well mixed in the soil by cultivation the next spring, furnishes one of the best seed beds in which to plant corn. This is the method employed by a Pennsylvania farmer, who reports that his yield has not been less than 100 bushels of corn per acre during the past twelve years, with the exception of two seasons. He also practices frequent shallow cultivation in a manner well suited to conserve the soil moisture, and is confident that with average rainfall during fall, winter, and early spring he can raise a fair crop without any rain from planting time until harvest. A field of his corn, as seen in August, 1902, is shown in Pl. XIV, fig. 1, when it appeared that the yield would exceed 100 bushels per acre. A later report gives 130 bushels as the average yield from 90 acres. Some implements used on this farm are shown in Pl. XIII, fig. 2—on the left a 4-horse or 5-horse cultivator, used in the spring for loosening and tearing to pieces the clover sod plowed under in the autumn, and on the right a planter made expressly to plant corn according to this farmer's idea of the best method for his farm.

Whatever may be the system of crop rotation, all fields which are subject to blowing or washing of the soil should be kept covered with some crop during the winter. This is usually advisable, even though the field is not subject to blowing or washing, and if the proper crop is grown during fall and early spring it will enrich the soil when plowed under. If oats are to follow a corn crop, clovers, cowpeas, soy beans, velvet beans, wheat, rye, or some other crop should be planted in the cornfield at the last cultivation, or as soon as the corn is cut. Although such crops may not have time to make much growth,

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[a] "Bacteria and the nitrogen problem," by George T. Moore, Yearbook of the U. S. Department of Agriculture, 1902, p. 333.

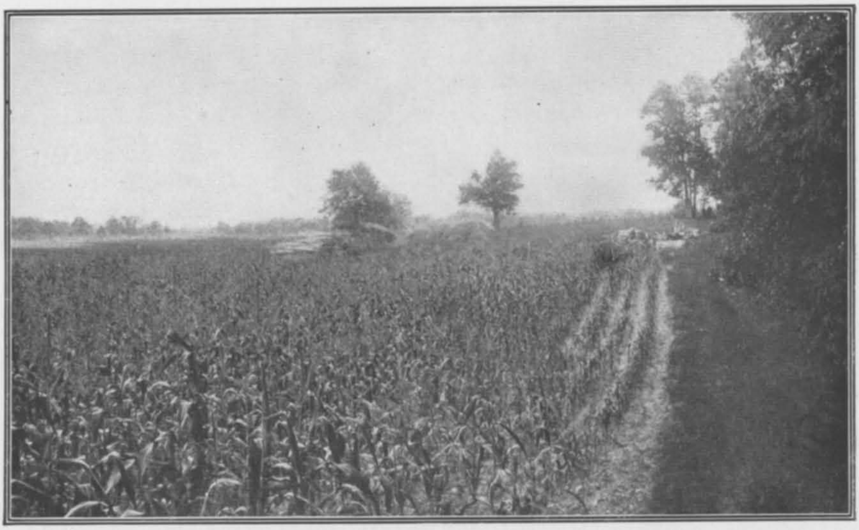

FIG. 1.—AVERAGE PRODUCTION REDUCED BY CLOSE PROXIMITY TO TIMBER.

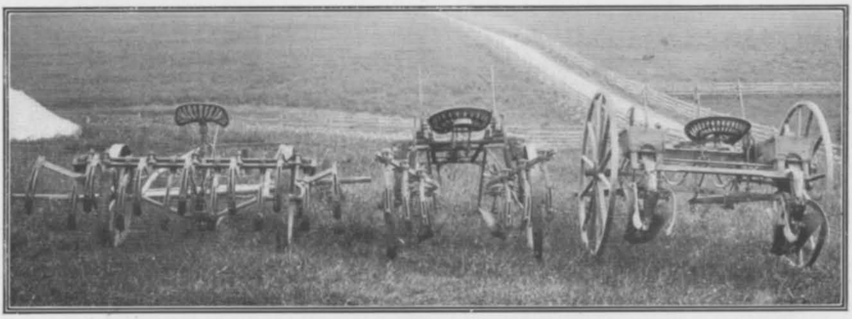

FIG. 2.—IMPLEMENTS USED IN PRODUCING 100 BUSHELS OF CORN PER ACRE.

FIG. 3.—NARROW SHOVELS AND FENDERS FOR EARLY CULTIVATION.

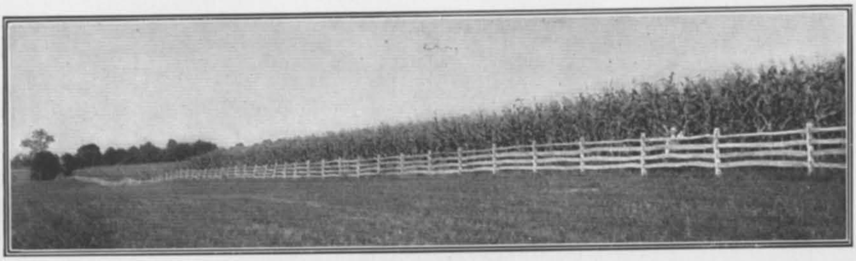

FIG. 1.—A PENNSYLVANIA FIELD THAT PRODUCED OVER 100 BUSHELS OF CORN PER ACRE.

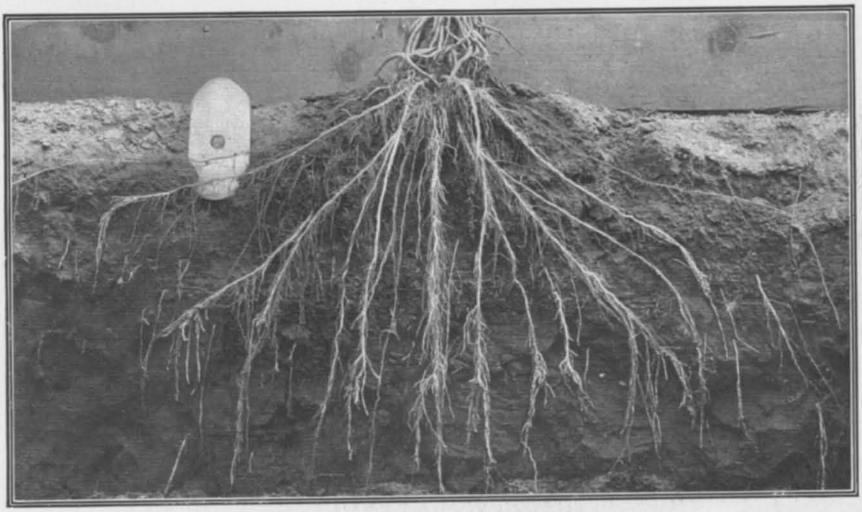

FIG. 2.—ROOT DISTRIBUTION AT SILKING TIME.

[Bottom of board represents soil surface.]

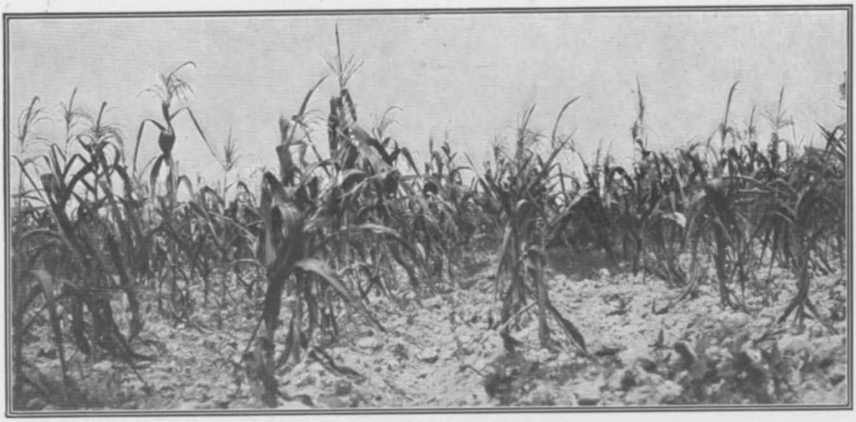

FIG. 3.—INJURIOUS RESULTS FROM CULTIVATION GIVEN AFTER GROUND HAD BECOME TOO DRY.

they will protect the soil during fall, winter, and early spring, and add to its fertility when turned under or uprooted by cultivation. The growing of beans, peas, clovers, etc., is a great help to the soil even though the seed be gathered or the vines cut for hay, but the turning under of the entire crop enriches the soil to a greater extent and on poor soils causes a very noticeable increase in yield for two or more years.

FALL PLOWING.

Fall plowing can not be recommended for all soils and localities, but should be more generally practiced than at present. If a cover crop or sod is turned under in the autumn, decomposition will increase the amount of plant food available for the crop the next summer. This is true to some extent even though sod is not turned under, inasmuch as the simple loosening of the soil admits atmospheric oxygen and increases chemical action upon vegetable and mineral matter. Fall plowing is one of the methods of combating grubworms, cutworms, and corn-root worms, which are often destructive to corn. Because the surface of ground plowed in the fall is drier at planting time in the spring than that of ground not so treated, it does not necessarily follow that there is less moisture in fall-plowed ground. The fall plowing has enabled the rainfall better to penetrate the subsoil, allowing the surface to dry more rapidly. In the spring fall-plowed fields usually contain much more moisture, but at the same time have a drier surface than fields which remain undisturbed until spring. In sections where there is much rain during the winter it is better not to harrow the fall-plowed land in the autumn. This is especially true of fine clay soils that run together and pack readily. In comparative tests of fall and spring plowing, preceding a dry summer, the fall-plowed fields have generally yielded better. The same is true of subsoiling. Deep spring plowing and spring subsoiling are likely to result in diminished crops, especially if done after the spring rains. The loosening of the soil to great depths admits air and facilitates the loss of soil moisture; it also interrupts the capillarity, so that moisture is not as readily drawn from greater depths, and during a dry summer there is not enough available moisture to support a good crop.

DEPTH OF PLOWING.

From the above, it is plain why there has been so much contradictory evidence regarding the best depths to plow for certain crops. For a deep, rich soil deep plowing is best, providing it is done in the fall or does not render the soil too loose and dry. For thin clay soils subsoiling is better than very deep plowing, because it does not turn the compact clay to the surface, yet at the same time loosens the soil to a good depth. The plowing should not be at the same depth from year to year, as by such a practice the soil is not mixed well and a hard

surface is left at the bottom of the furrows where the horses walk and the plows drag. A little subsoil turned to the surface occasionally allows the elements to act upon it, liberating plant food, and as it becomes mingled with surface soil and vegetable growth the soil depth will be increased. To accomplish these desired results it is well to plow a little deeper each year for several successive seasons, and then for one season give a plowing at about half the depth of the deepest plowing. It is well to have the farm mapped, the various fields numbered, and records kept of the annual treatment and production of each field.

PLANTING.

Throughout all corn-growing sections of the country it is the general experience that corn planted early most often gives the best yield. Occasionally later plantings yield best, but they are exceptions. In 1902 the writer saw fields of corn in Georgia, planted in February, that yielded 40 bushels per acre, and others adjoining, planted two months later, that did not produce 5 bushels per acre. In the Northern States there is little choice as to time of planting. Corn must be planted as soon as the ground is sufficiently warm, in order that it may mature before early fall frosts. In the Southern States the growing season is long enough to allow planting at different dates, thus lessening the likelihood of having the entire crop cut short by drought. Growing conditions are more favorable in the spring, and corn usually produces better if planted at that time. Although the Southern summers are long enough to afford plenty of warm weather, corn planted in the summer will ripen in less time and usually produces less than if planted in the spring. Fields planted early frequently escape attacks of the bud-worm, while later plantings of the same year suffer severely. As the result of many years' trials at different State experiment stations the best planting season has been found to be, respectively: Middle Georgia, March 15 to 20; Illinois, May 11 to 18; middle Indiana, May 1 to 11; Kansas, May 2; South Dakota, May 10 to 20.

Corn should, of course, not be planted in cold or wet ground simply because the calendar shows that the usual planting time has arrived; but by good drainage, fall plowing, etc., every farmer should strive to have his land in good condition to plant at the proper time. Underground drainage will prove most profitable in the end, but as this is rather expensive it is sometimes desirable to use low, flat land for corn before it is possible to have it tile drained. Sometimes such fields are plowed in small strips or "lands" 4 to 6 feet wide, and a row of corn is planted on the ridge or backfurrow of every land. This places the plants above surface water, and for this reason is satisfactory during wet weather, but the high situation of the stalks places them at a disadvantage during dry weather. The method of planting illustrated

in fig. 3 gives more general satisfaction for such fields. The ground is backfurrowed in lands 8 feet wide, making thereby dead furrows every 8 feet. On each side, and 2 feet from each dead furrow, shallow rows are marked off, and in them the corn is planted. By this method the plants have drainage during wet weather and are better situated for enduring drought than when standing on the higher ridges.

A little more care can be exercised to advantage as regards dropping a precise number of kernels and covering them with mellow soil when the planting is done by hand, but the labor saved by the use of planters is so great that for profitable corn growing their use is indispensable. Moreover, if the seed bed is in the proper condition any good planter can be made to cover corn as satisfactorily as it can be done with a hoe; and, if seed ears having kernels of uniform size be selected and the small kernels at the extremities of the ears be rejected, good modern corn-planting machines can be made to drop with sufficient accuracy for practical purposes. However, the yield depends to such an extent upon the proper number of stalks and their even distribution that too much stress can hardly be placed upon the necessity for selecting seed ears having kernels of uniform size and plates for the planter that will drop the proper number at the required distance. Every spring the planter should be thoroughly tested and adjusted until it will drop

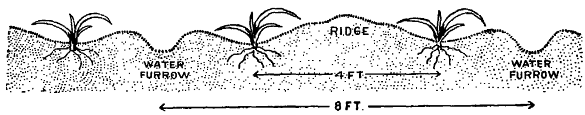

FIG. 3.—Planting system for low wet land.

accurately the seed to be used. These are some of the many essentials that can be attended to before the rush of planting time arrives.

DEPTH OF PLANTING.

The proper depth to plant must be governed by the quality and moisture of the soil. If it is a stiff, heavy clay containing plenty of moisture at planting time, 1 inch is sufficiently deep; but if it is a light, open, dry soil, 3 or 4 inches is a satisfactory depth. If the corn is planted deeper than 4 inches much of the food supply stored in the seed will be consumed before the young plant can reach the surface and expand its leaves. Plants can not be made to send their roots deeply into the soil by planting the seed deeply. They can better be fortified against dry weather by planting the seed in a furrow, covering it slightly, and then gradually cultivating the furrow full of soil as the plants grow. This requires some care, however, as the furrow should not be filled to any great depth until the plants have attained a height of a foot or more and are in a vigorous condition. This method of planting is especially well adapted to deep soils where dry weather is likely to prevail during the middle or latter part of the growing season.

The lister, the implement with which a large part of the corn is planted in the Prairie States, fulfills the requirements of this method of planting.

PLANTING WITH A LISTER.

The lister (fig. 4) is used for planting fields that have been thoroughly plowed and also for planting directly in last year's cornfield or stubble field without previous preparation. This latter practice, however, is not recommended for shallow or stiff clay soils.

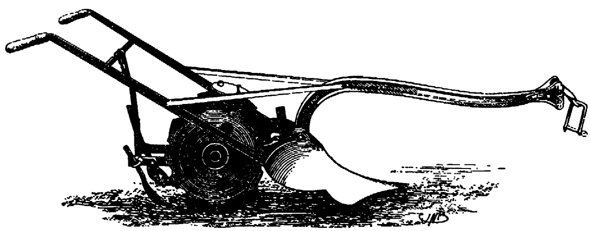

FIG. 4.—Lister with drill attached.

The results of a majority of the comparative tests in the deep soils of the States just west of the Mississippi River have been in favor of listed rather than surface-planted corn, and the increased yield of listed plats has been greatest in dry seasons. By planting in a deep furrow, as is done with a lister, weeds in the corn rows are more easily covered by cultivation, and as the furrow becomes filled by cultivation the root system is placed at a greater depth. The corn is thus better enabled to endure drought, and the stalks are not so easily blown down. On soils where corn can be listed without previous preparation of the ground, this method is profitable because of the labor saved, but it can be successfully employed only on very deep, loose soils. When the drill is attached to the lister, as is shown in the illustration, one man with three strong horses can do in one day all the work connected with the planting of 7 acres of corn. The drill is so constructed that it can be detached from the lister and used separately. By this means an additional man and horse are required to drill the corn in the furrows made by the lister. If the soil is stiff and heavy it should be well plowed and brought into good condition for planting before the corn is listed. A lister or a planter with lister

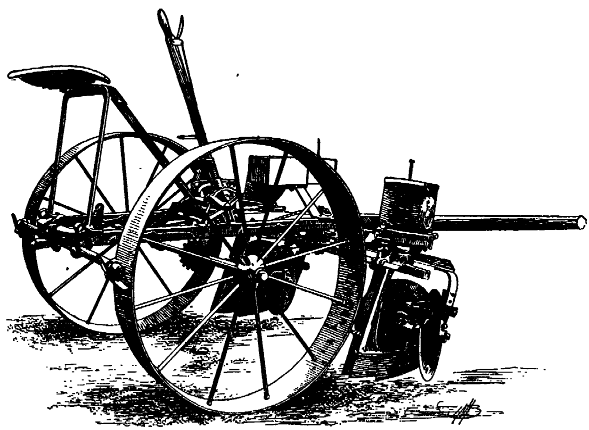

FIG. 5.—Planter with disk attachments.

attachments (fig. 5 and Pl. XIII, fig. 2), which lists two rows at once and makes a mark to guide the driver on his return, can then be employed. Disks or double moldboards, similar to those shown, could be attached to the various makes of planters and check rowers, and thereby the corn could be planted in the bottom of furrows below the general surface of the field. For the reasons mentioned, this method of planting would be an improvement for many localities where extensive areas of corn are yearly planted by means of check rowers which leave the surface of planted fields smooth.

PLANTING WITH A CHECK ROWER.

Perhaps more corn is now planted by means of a check rower than by any other device. This implement is adjustable, so that the spacing of the rows and the distance between the plants or hills in the row can be regulated to suit the requirements of the soil. By means of the wire chain stretched across a field one man and team can plant in straight rows in both directions across the field 12 or 15 acres per day, thus admitting of cross cultivation. Corn planted in this way can be kept free of weeds and well cultivated without costly hoeing or the cutting of weeds. A summary of numerous tests made by various State experiment stations shows that there is practically no difference in yield of corn planted in hills of several stalks each or drilled so that the stalks stand separately in the rows, provided there is the same number of stalks per acre in each case. The former system facilitates cultivation and the latter provides for a more equal distribution of roots throughout the soil. Check rowers are best adapted to large and comparatively level fields free from trees or stumps. Hillsides and sloping ground can not be planted in checks without increasing the liability to soil washing.

DISTANCES BETWEEN ROWS AND HILLS.

The distances between rows and stalks or hills in the rows affect to a great extent the production per acre. A proper number of stalks evenly distributed, so that none will suffer from crowding and so that there will be enough to produce the greatest number of well-formed ears, constitutes the best stand for the production of ear corn. If planted thicker than this the weight of stover increases and the production of good ears decreases. If planted thinner the weight of stover as well as of ears decreases. Small-growing varieties should be planted thicker than varieties producing tall stalks. The scope of this article precludes the giving of specific directions as to the best distances for planting the various strains of corn, but remembering that for greatest production rich soil requires thicker planting than poorer soil, each farmer must determine the best distances for his particular corn and soil. In 1897, 1898, and 1899 the Georgia experiment

station[a] obtained the best results by having the rows 4 feet apart and the stalks 3 feet apart in the row. In 1900 the conclusion was reached that for upland soils, capable of producing from 35 to 40 bushels of corn per acre, rows 4 feet apart, with one plant every 2 feet, would yield a larger quantity of grain than any greater or less distance. As an average for eight years the Indiana State experiment station[b] obtained best results from rows 3 feet 8 inches apart, with the stalks 10¾ inches apart in the rows. On many farms of slight fertility in the leading corn States of the Mississippi Valley the annual yield is considerably reduced because the corn is planted as thickly as would be advisable on fertile prairie or bottom soils. Here, the thinner planting practiced in regions generally less fertile could be adopted with advantage. Where the soil is so poor as to necessitate the placing of corn rows 5 or 6 feet apart, it is best to grow another crop between the rows. Pindars or peanuts, cowpeas, soy beans, or other leguminous crops are well adapted to this purpose. They enrich the soil and do not interfere with the growth of the corn.

The distance for planting in a particular soil should be decided upon and the planter adjusted to plant accurately and regularly. Spots missed by the planter, as well as those depleted by crows, insects, etc., greatly decrease the yield per acre. The custom of planting a little thicker than the stand of stalks desired is not a good one. It may meet the requirements for small patches that can be thinned by hand to the desired stand, but hand thinning large fields is too tedious to be profitable. If the seed shows a germination of 97 per cent or more in a thorough germination test and it is then properly planted the stand will be almost perfect unless very adverse weather ensues, in which case all the plants will be so injured that the planting of the entire field again will be preferable to replanting the missing hills and will be more easily accomplished. It is not only a waste of land to have missing hills in a cornfield, but also a waste of labor in cultivating them. If a field has been drilled in but one direction and for any reason a poor stand is obtained, it can be replanted with a check rower set to drop one kernel at a time operated without the tripping chain. The check rower is driven at right angles to the rows of the first planting and operated so as to plant just as it crosses each row. For this purpose two men will usually be required, one to drive and one to trip the check rower as it crosses the corn rows.

IMPORTANCE OF THOROUGH EARLY CULTIVATION.

The most successful corn growers realize the importance of thorough early cultivation, thus preventing any check in the growth of the plants because of weeds or crusted soil. The farmer should see that,

[a] Bulletin 51, Georgia Experiment Station, 1900, p. 287.
[b] Bulletin 50, Indiana Experiment Station, 1894, p. 46.

from the time of germination to the maturing of the corn, the plants are not subjected to any unfavorable conditions, but are given an opportunity to make a steady, vigorous growth. If their development is checked from any cause they will never fully recover, no matter how favorable the later treatment. As a consequence of heavy rainfall the stalks may increase rapidly in height, and at the same time, for lack of cultivation or of plant food, or for other reason, they may be slender or of poor color. Thrifty corn plants are thick, strong, and of dark green color.

Horse weeders and harrows should be used when needed to break a surface crust or kill young weeds that start before the corn is up or large enough to be worked with other implements. During the first cultivation, or while the plants are very small, narrow shovels that throw the soil but very little should be used, and fenders are usually found desirable to prevent the covering of the plants (Pl. XIII, fig. 3).

DEPTH OF CULTIVATION.

Many comparative experiments of deep and shallow cultivation have been made, and on the whole the results are in favor of shallow cultivation. There are but few occasions when deep cultivation is preferable. If excessive rains have packed the soil and kept it water soaked deep cultivation will help to dry and aerate the soil. Breaking the roots of the plants must be avoided so far as possible (Pl. XIV, fig. 2). If roots are broken the plants will rapidly produce other roots, but it will be at the expense of the vitality and food supply. After the plants have reached a height of 3 or 4 feet, the soil even in the middle of the rows should not be cultivated deeper than 4 inches, and 3 inches is usually better. For retaining soil moisture a loose soil mulch 2 or 3 inches in thickness should be maintained.

FREQUENCY OF CULTIVATION.

The best answer to the question of how frequently corn should be cultivated is that it should be cultivated often enough to keep down weeds and to maintain constantly a loose soil mulch till the corn has attained its growth. To this end a greater number of cultivations will be necessary when rains at intervals of about a week cause the surface soil to run together and crust. This crust must be broken and the soil mulch restored, or evaporation will soon rob the soil of its moisture. It is a mistake to think that the longer the drought the more frequent should be the cultivations. After a fine mulch of about 3 inches in depth has been produced, its frequent stirring is not necessary except in so far as it is required to keep weeds from starting. The essential object of cultivation is to restore the soil mulch as soon after a rain as the condition of the ground will permit. If this time

is allowed to pass and the ground becomes hard and baked dry, the crop will suffer greatly, for the cultivation of hard, dry ground breaks it up into clods, allowing the air to penetrate to greater depth and causing more injury than if such cultivation had not been given at all. All observant farmers have seen crops injured in this manner (Pl. XIV, fig. 3). Many crops are cut short by stopping the cultivator because the corn is too tall for the use of a double cultivator without breaking down the stalks. If the condition of the soil demands it, shallow cultivation should continue even though the corn is tasseling. Fig. 6 shows a convenient implement which can be used with a short singletree for maintaining a soil mulch after the corn is too tall for the use of double cultivators.

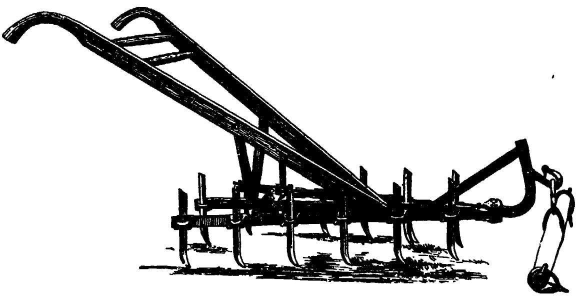

FIG. 6.—Implement for maintaining soil mulch in tall corn.

KINDS OF CULTIVATORS.

With a good riding or walking double cultivator one man can cultivate as many acres as two men with a one-horse cultivator, and with the most improved types he can accomplish the work more easily and fully as well. Because of this saving of labor, double cultivators should be used wherever practicable. Two-row cultivators equipped with four gangs of shovels and drawn by three or four horses are meeting with favor in the Central Prairie States. As these complete the cultivation of two rows of corn each time they cross the field, one man can cultivate 15 acres per day. Some of these cultivators are mounted on two wheels like two-horse cultivators, while others made for plowing listed corn are carried on runners designed so as to follow the rows made by the lister. Very stumpy land or tall corn may necessitate the use of one-horse cultivators.

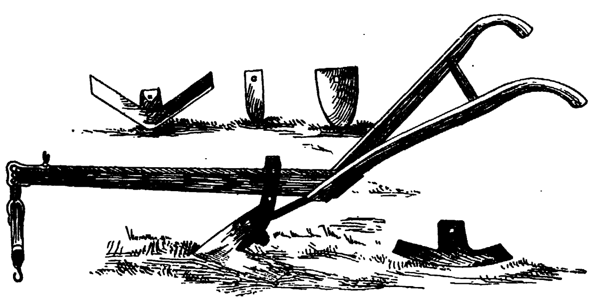

FIG. 7.—Sweeps and shovels used on a one-horse cultivator.

The kind of shovels with which it is best to equip either single or double cultivators must be determined by the character of the soil, size of the corn, and the size and nature of growth of the weeds to be destroyed.

FIG. 1.—THE PROUT HORSE HOE OR HOEING MACHINE.

FIG. 2.—SURFACE CULTIVATOR AND DISK CULTIVATOR AT WORK.

FIG. 3.—A GOOD MODERN DOUBLE CULTIVATOR.

Without exception, any form of shovel found to do good work on a one-horse cultivator can be attached to a double or a two-row cultivator. For light, sandy land, sweeps (fig. 7) are in great favor, and are of various widths from 6 up to 30 inches. The sweeps scrape along through the soil at a depth of from 2 to 3 inches, cutting off weeds, and allowing the surface soil to pass over them and fall in a level manner behind the cultivator. The same results are accomplished with a double cultivator used in New England, where it is known as a horse-hoe or hoeing machine (Pl. XV, fig. 1). This implement was made originally for tobacco cultivation, the long horizontal blades which extend toward the row from the vertical stocks serving well to reach under the tobacco leaves and cut weeds and loosen the soil without breaking the leaves. In the illustration the horizontal blades are under the soil and can not be seen. Shovels which accomplish the same purpose are used on double cultivators, and in the Central States are called surface cultivators (fig. 8). In the field shown in Pl. XV, fig. 2, the surface cultivator was doing better work than the disk cultivator, which left narrow strips of solid soil that were not covered with fine, loose soil. All forms of shovels should be so adjusted that the loosened soil will make a fine and even covering for the harder soil beneath. The surface cultivator shown in fig. 2 of Pl. XV, bears two attachments for smoothing the soil behind the shovels. It is a very easy matter to have the local blacksmith so form the cultivator shovels that they will accomplish good results in the kind of soil in which they are to be used. Fig. 9 shows shovels modified at the farm

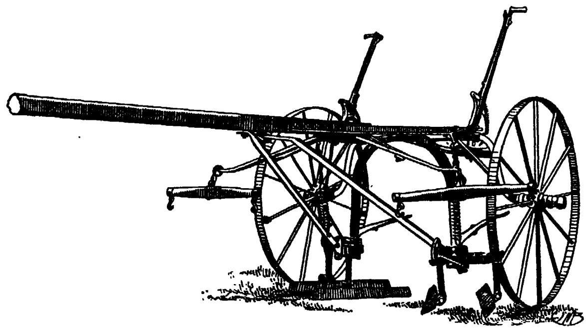

FIG. 8.—Double cultivator equipped for surface cultivation.

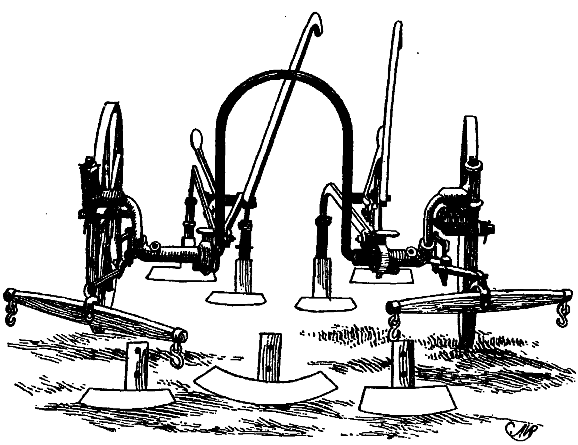

FIG. 9.—Homemade shovels adapted to surface cultivation and weed destruction.

blacksmith shop for use on river bottom land, where bind-weed, man-of-the-earth, and other troublesome weeds are hard to control. The horizontal blade at the bottom of the shovel strikes the weeds so squarely that there is little chance for them to escape by slipping by either side, as is so common with ordinary shovels.

Almost all styles of double cultivators are made either with handles, as walking cultivators, or with a seat, as riding cultivators. The latest forms of riding cultivators are easily and readily manipulated and do good work. Pl. XV, fig. 3, shows a modern cultivator, the shovels of which are shifted in unison to the right or to the left by a straight forward pressure with one or the other foot. Some cultivators, which require lateral pressure with the feet for guiding the shovels, are tiring to the operator. A sunshade adds but little to the cost of the cultivator and makes the work less irksome. Such appliances should not be regarded as devices of the lazy. To do work in a laborious manner when it can be done equally as well and as quickly in a pleasant way is folly. It lessens the laborer's capacity for work by exhausting his energy, so that he can do less than he would be capable of doing were he to perform it in an easier way. No worker is more entitled to the advantages of mechanical devices that will ease his labor or increase his comfort than he who produces the food supply of the world.

THE ECONOMIC VALUE OF THE BOBWHITE.

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Introduction.

No birds have so firm a hold on public interest as the game birds. The laws enacted on their behalf exceed in number a hundred fold those relating to other kinds of birds. Among game birds the bobwhite is held by many to be preeminent. Easily accessible over a wide area of the country, small enough of size and swift enough of wing to test the sportsman's skill, delicious enough to please the epicure, to most sportsmen it is without a peer, the king of our feathered game.

The name 'bobwhite' is derived from a fancied resemblance to this word in the familiar utterance of the bird. It has been adopted by several writers because of the inaccuracy of the two names by which the species is usually known—quail in the North and West and partridge in the South. The name 'quail' properly belongs to a smaller migratory bird of a different genus, found in the Old World, the quail of the Bible story; while 'partridge' in New England, universally applied to the ruffed grouse, is strictly the name of another Old World genus, though also used to designate the group to which bobwhites, quail, partridges, and other closely related birds belong.

The bobwhite (*Colinus virginianus*—Pl. XVI) is found from southern Maine and southern Ontario to the Gulf of Mexico, except in mountainous regions, which are too cold for it, and exclusive of southern Florida and southern Texas, in each of which an allied race occurs. It ranges as far west as South Dakota and eastern Colorado. It has been introduced into New Mexico, Utah, Idaho, California, Oregon, Washington, and the island of Jamaica. The bobwhite of Florida (*Colinus virginianus floridanus*), which is confined to the peninsula, is a much smaller and darker bird than its Northern relative. The Texas subspecies (*Colinus virginianus texanus*), which is resident north to western Kansas and south into Mexico, though no smaller than the Northern form, is less deeply colored and somewhat differently marked. At least ten subspecies occur in Mexico, many of them differing markedly in appearance from the familiar bobwhite of the United States, but with no appreciable difference in notes. In the present paper the Mexican races are excluded, and the Florida and Texas forms are not distinguished from the common bobwhite.

The æsthetic pleasure derived from the presence of the bobwhite has a certain definite value. Much money has been spent for merely the enjoyment of the beauty and companionship of birds. For the protection of gulls and terns along the Atlantic coast thousands of dollars have been appropriated at the instance of bird lovers in whose eyes these delicate creatures are the crowning grace of a marine landscape. To pastoral inland scenes—woodlots in a green mist of young leaves, summer grass fields and bushy pastures, brown stubble and skeleton cornfields—the bobwhite adds a charm, homely but no less enjoyable. As it calls in summer from the fence post or runs fearlessly across the road, the stroller can see it closely enough to admire its trim, alert figure, and its tasteful color pattern of black, white, and brown, set off by delicate tintings of blue. Its mellow whistle seems a proffer of good-fellowship, investing even a solitude with cheerful friendliness, while the plaintive covey call, heard in the growing darkness as it summons a scattered flock to its nightly resting place, is one of the tenderest of evening sounds. Many people, appreciating these features of its presence, welcome the bird for the pleasure of its company, and are ready to spend time and money to keep it undisturbed in their neighborhood. The writer has known several men who, for this purpose, incurred considerable expense in posting land and hiring keepers to prevent poaching. There are no doubt many who, in similar ways but with smaller outlay, set up some measure in money for the æsthetic value of the bobwhite.

In three ways the bobwhite is of strictly economic importance—as a destroyer of noxious seeds and insects; as a delicate and nourishing food; and as an object of sport.

The Bobwhite as a Weed and Insect Destroyer.

A study of the bobwhite was undertaken by means of field observations, experiments with captive birds, and examination of the contents of crops and stomachs in the laboratory. The results obtained may be thus summed up: The bobwhite is probably the most useful abundant species on the farm. It is one of the most nearly omnivorous birds, consuming large quantities of weed seeds, and destroying many of the worst insect pests with which the farmer has to contend. It does not injure grain, fruit, or any other crop.

FOOD OF THE BOBWHITE.

In the investigation 801 stomachs were examined, collected in every month of the year, though mostly during the hunting season, and obtained from 21 different States, and from Canada and the District of Columbia, but chiefly from New York, Maryland, Virginia, Florida, Ohio, Indiana, Illinois, South Dakota, Nebraska, Kansas, and Texas.

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BOBWHITE IN POTATO FIELD.

As indicated by this material, the bobwhite is notable for the great variety of its food. It lives mainly on seeds, fruits, leaves, buds, insects, and spiders, though myriapods, crustaceans, mollusks, and even batrachians have been found in its stomach. The character of the diet varies with the season. The greatest proportion of animal matter is taken in late spring and early summer. The food for the year as a whole, estimated from the analysis of the contents of stomachs, and calculated by volume, is divided thus: Animal matter, 14.93 per cent; vegetable matter, 85.07 per cent. The elements of the animal food are distributed as follows: Beetles, 6.38 per cent of the total food; grasshoppers, 2.56 per cent; bugs, 2.83 per cent; caterpillars, 0.87 per cent; miscellaneous insects, 0.48 per cent; other invertebrates, largely spiders, 1.81 per cent. The vegetable food consists of grain, 23.64 per cent of the total food; various seeds, chiefly those of weeds, 50.78 per cent; fruit, 8.53 per cent; miscellaneous vegetable matter, 2.12 per cent.

SEEDS.

The bobwhite is preeminently a seed eater. Of its food for the year as a whole, seeds form 50.78 per cent, and include those of many different plants.

The bulk of this seed diet consists of the seeds of weeds. Fully 60 different weeds are represented in the food and constitute more than a third of the food for the year as a whole. Some idea of the value of the bird as a weed destroyer may be gained from the number of seeds taken at a meal. Thirty buttonweed seeds, 200 to 300 smartweed seeds, often 500 seeds of sheep sorrel, and 700 of three-sided mercury have been taken at one feeding. Crops and stomachs are frequently crammed with nothing but ragweed. One bird, taken at Marshall Hall, Md., November 6, 1902, had eaten a thousand ragweed akenes; another, killed the previous November in the same place, had eaten an equal number of the seeds of crabgrass, a troublesome weed in truck land. Birds have been shot in Mecklenburg County, Va., whose stomachs contained 3,000 leguminous seeds, mostly of tick trefoil and various species of bush clover. Pigeon grass, which is extremely common and mischievous in truck land, is a favorite food. No less than 5,000 seeds of this troublesome plant were found in the stomach of a bird shot in October, 1902, at Pinebrook, N. J. Finally, a bobwhite taken on Christmas Day, 1901, at Kinsale, Va., was discovered to have eaten 10,000 seeds of that abundant and obnoxious pest of the garden, the pigweed.

A careful computation of the total amount of weed seed the bobwhite is capable of destroying is surprising in the magnitude of its result. In the State of Virginia it is safe to assume that from September 1 to April 30, the season when the largest proportion of weed

seed is consumed by birds, there are four bobwhites to the square mile, or 169,800 in the entire State. The crop of each of these birds will hold half an ounce of seed, and as at each of the two daily meals weed seed constitutes at least half the contents of the crop, or a quarter of an ounce, a half ounce daily is certainly consumed by each bird. On this very conservative basis the total consumption of weed seed by bobwhites from September 1 to April 30 in Virginia amounts to 573 tons.

ANIMAL FOOD.

The bobwhite is insectivorous as well as granivorous. Insects are eaten during every month of the year, and amount to 14.93 per cent of the food for the year as a whole.[a] From May to August, inclusive, when insects are most numerous, the percentage for the period rises to 31.5 per cent. The variety of insect food is large. In the present investigation 116 species of insects have been noted as entering into the diet, a number that will probably be greatly augmented by further knowledge. Furthermore, the proportion of injurious insects habitually eaten by the bobwhite makes its services as a destroyer of insects more valuable than those of many birds whose percentage of insect food, though greater, includes a smaller proportion of injurious species. Conspicuous among the pests which the bobwhite destroys are the potato beetle, the 12-spotted cucumber beetle, the bean leaf-beetle, the squash ladybird, wireworms and their beetles, May-beetles, such weevils as the corn bill bug, the imbricated snout-beetle, the clover leaf weevil, and the Mexican cotton boll-weevil, the striped garden caterpillar, the army worm, the cotton worm, the boll worm, various species of cutworms, the corn-louse ant, the red-legged grasshopper, the Rocky Mountain locust, and the chinch bug. Some of these pests are relished, for a dozen army worms or cutworms are frequently eaten at a meal. Thirty Rocky Mountain locusts have been found in a single crop. Weevils are greatly sought after, 47 cotton boll-weevils having been eaten in a morning by one bobwhite. Striped cucumber beetles are destroyed by the score, potato beetles by the hundred, and chinch bugs by the tablespoonful.

From May to August, inclusive, beetles form 17.9 per cent of the food of the bobwhite; bugs, 6.2 per cent; caterpillars, 2.4 per cent; grasshoppers, 2.3 per cent; miscellaneous insects, 0.8 per cent, and spiders and other invertebrates, 1.9 per cent.

The losses caused by some of these pests show how desirable it is to protect a bird that habitually destroys them. The Mexican cotton boll-weevil damages the cotton crop to the extent of $15,000,000 a

[a] Including 1.81 per cent of allies of insects, principally spiders, with a few snails, crustacea, and other invertebrates.

year,[a] the potato beetle lops off $10,000,000 from the value of the potato crop,[b] and the cotton worm has been known to cause in a year a loss of $30,000,000.[c] The chinch bug[c] and the Rocky Mountain locust,[d] scourges that leave desolation in their path, have each caused, in certain years, a loss of $100,000,000.

By far the greatest insect destruction by the bobwhite occurs during the breeding season. Not only does a third of the food of the adult birds then consist of insects, as has been stated, but their growing broods consume insects in enormous quantities. The food of the young of practically all land birds contains a much greater percentage of insects than that of the mature birds; and the amount of food the young require is immense in proportion to their size. No stomachs of young bobwhites have been examined in this investigation, but 19 droppings that were collected from two broods of chicks, on July 24, 1902, disclosed a purely insectivorous diet.

GRAIN.

An impression prevails among sportsmen who have bagged most of their game on the stubble field that the bobwhite eats little else than grain. The analysis given above shows, however, that grain forms only one-fourth of the food. Corn and wheat appear to be eaten in greater quantity than other cereals. The former constitutes 19.14 per cent of the food, the latter 3.04 per cent. As experiments with captive birds fail to show any marked preference for either corn or wheat, the disproportion between the two cereals in the usual food is due to some other cause, probably the fact that more corn than wheat is grown in the part of the country where bobwhites are most abundant. The remaining cereal food, 1.46 per cent of total, is composed of miscellaneous grain, including kafir corn, sorghum, millet, barley, oats, and rye.

Grain-eating birds, as a rule, are likely to do much harm to crops. They may pull up sprouting grain, plunder the standing crop when it is in the milk, or forage among the sheaves of the harvest field. The bobwhite, however, is a notable exception. It is necessarily in the period of germination that grain is susceptible of the most serious injury. Nevertheless not a single sprouting kernel was discovered in the contents of the crops and stomachs examined in this investigation.

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[a] According to information received by the Division of Entomology of the Department of Agriculture. This is a statement of the actual damage caused the crops of 1903 by the Mexican cotton boll-weevil, which, in this country, is practically confined to some of the cotton-producing counties of Texas. The damage is 50 per cent of the entire crop of the infested territory, and as the normal cotton crop of the United States is estimated to represent a value of $500,000,000, the probable ultimate damage, when the pest, if not checked, has spread over the entire cotton belt, may amount to about $250,000,000 a year.

[b] Insects Injurious to Staple Crops, by E. Dwight Sanderson, 1902, p. 3.

[c] Bulletin 5, U. S. Entomological Commission, p. 7.

[d] First Report U. S. Entomological Commission, 1878, p. 121.

Some field observations made in 1899 and 1900 at Marshall Hall, Md., give confirmatory evidence. While crows injured sprouting corn so seriously during May that several extensive replantings were necessary, the bobwhite, which was unusually abundant at the same time in the vicinity, was never seen to disturb germinating grain. No data are available regarding rye and millet, but in newly sown buckwheat fields of Essex County, N. J., which the writer saw ravaged by doves, there was no sign of injury by the bobwhite. Publications on economic ornithology and reports received by the Biological Survey add testimony of like character. It may be safely asserted, therefore, that so far as is at present known, the bobwhite does no appreciable harm to sprouting grain. Damage to grain at any other time entails a loss of a comparatively insignificant part of the crop.

In order, however, to learn how far the bird might injure ripening wheat, observations were made for several years at Marshall Hall, Md. During November immense flocks of crow blackbirds made such havoc in winter wheat that diligent use of the shotgun was necessary to save the crop. But no bobwhites were ever seen in the act of taking grain. A hen bird shot June 18, 1903, in a field of ripe wheat, however, had much grain in its crop, though whether it obtained the food from standing stalks or from kernels dropped on the ground was not known. As the bobwhite usually feeds on the ground, the latter source appears the more probable. Farmers whom the writer has consulted, who were well aware that goldfinches feed on ripening oats, that English sparrows take wheat, that crows tear open field corn, and that red-winged blackbirds ruin whole fields of sweet corn, say that the bobwhite does no harm to standing wheat or other standing grain.

The bird is, however, a notorious stubble feeder. Where fields of wheat stubble support a rank growth of ragweed, as in some of the Eastern States, the sportsman is most likely to find a covey feeding. On the Western plains no ragweed grows amid wheat stubble, therefore the birds are more often found in cornfields where the stalks have been left standing after removal of the ears. In such a place at Badger, Nebr., six bobwhites were shot in November, 1901, whose corn-distended crops contained in all 181 kernels. Birds that feed in wheat stubble often take from 100 to 200 grains of wheat at a meal. A bobwhite was taken in December, 1902, at West Appomattox, Va., whose crop contained 508 grains of wheat, and was distended almost to bursting. This habit of gleaning waste grain after harvest is beneficial to the farm, as the germination of volunteer grain is not desirable, especially where certain insect pests or parasitic fungi are to be combated. As the scattered kernels are often too far afield for domestic poultry to gather, the bobwhite's services in this respect are especially useful.

FRUIT.

The bobwhite eats fruit to the extent of 8.53 per cent of its diet for the year, a very moderate proportion compared with the corresponding proportions in the diets of the catbird and the cedar bird, in whose food fruit forms one-half and three-fourths, respectively, of the whole. Although the amount of fruit eaten by the bobwhite is small, the variety is large.

The bobwhite is seldom troublesome to the horticulturist. Mr. M. B. Waite, of the Department of Agriculture, has reported its pecking into his ripening strawberries near Washington; but on the other hand, birds that were kept for several months in captivity for investigation refused strawberries at a time when they were hungry. The bobwhite is partial to wild grapes, and so might be expected to injure cultivated varieties, especially as its California relative, sometimes in a flock of a thousand, plunders vineyards; but so far as the writer knows, cultivated grapes have sustained no appreciable injury from bobwhites in the East. The period when the largest proportion of fruit (23.5 per cent of the total food) is eaten is not the season when man is gathering his fruit, but is during December, and sumac berries are then the fruit mainly eaten. Large quantities of dewberries, wax-myrtle berries, and bayberries also appear in the food. It may be interesting to note that the bobwhite is not nearly so frugivorous as the ruffed grouse.

LEAVES AND BUDS.

Neither does the bobwhite approach the ruffed grouse in destructiveness of leaves, buds, and tender shoots. It sometimes eats the leaves of yellow sorrel (*Oxalis stricta*), sheep sorrel (*Rumex acetosella*), red and white clover (*Trifolium pratense* and *T. repens*), and cinquefoil (*Potentilla* sp.). Captive birds ate grass, lettuce, and chickweed.

THE BOBWHITE AS AN ARTICLE OF FOOD.

The flesh of the bobwhite is juicy and of delicious flavor, easily digested, and highly nutritious. It is a very popular table luxury, and is well adapted to the needs of invalids. In families where fresh meat is not often available, it may furnish a welcome supply. No game is more popular in the market. Countless numbers of bobwhites are sold every year. There came to the writer's attention one instance of a single dealer in Washington, D. C., who in the year 1902 sold 100,000 of the birds. Still, the supply is far short of the demand, and the price is constantly rising. In connection with the present (1903) price, \$3 to \$5 per dozen, it is interesting to recall Audubon's statement that in 1831 these birds could be bought for 50 cents a dozen, and in 1810 for 12 cents.[a] Then they were found on the tables of rich and poor alike.

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[a] American Ornithological Biography, 1831, p. 392.

THE BOBWHITE AS AN OBJECT OF SPORT.

Edwyn Sandys says of the bobwhite: "He is truly the king of his race, and not only that, for, in the opinion of hosts of enthusiastic sportsmen, he is the best bird that flies."[a] Another well-known sportsman writer, T. S. Van Dyke, says: "Dear little bobwhite has brought more rest to the business-wearied soul, more new life to tired humanity, than nearly all other American game combined."[b] The pursuit of many other kinds of game is possible only in the far-off wilderness or plain, or where traveling is difficult and lying in wait a dangerous exposure; but the hunting of the bobwhite belongs to open, accessible country, and is not too severe a tax upon men unbraced by a sedentary life. To thousands of such men it is the yearly means of restoration, refreshing the senses and rejuvenating the whole body. On the stubble field, in pursuit of the bobwhite, man and dog are brought into close companionship. The bird lies well to the dog and offers an admirable shot. The winded covey crouches before the dog, often almost under its nose; then, exploding like a bomb, tests the skill of the hunter to bring one of the burring, meteor-like projectiles to the ground. Probably from 300,000 to 400,000 sportsmen go out from cities every fall to hunt the bobwhite. This means a considerable expenditure of money, much of which goes to owners of good shooting land. Where nonresident licenses are required, with their fees of from $5 to $25, the State also derives an income from the sport. Good hunting dogs are worth from $25 to $100, or more, each, and the keeping of many of them is intrusted largely to farmers, often at a remunerative figure. The training of these animals is also an item of expense. A good breaker charges $50, and at that price has all the dogs he can handle.

Paradoxical as it may seem, sportsmen exert a powerful influence for the protection of the bobwhite. Many individuals and clubs own or lease large tracts where they maintain the birds and kill off only the surplus. These enthusiasts assist in the enforcement of game laws, restock depleted covers, and provide food for the birds in times of scarcity. Certain clubs are organized for the purpose of holding field trials, the object of which is to test the ability of competing dogs to find and point birds. As retrieving is not required, the birds are not shot. One of the best-known patrons of field trials told the writer recently that he had not killed a bobwhite in ten years. A number of the clubs control each a preserve of from 5,000 to 30,000 acres, on which no shooting is allowed, and suitable measures are taken for protecting birds and facilitating their propagation. These trials are held in a score or more of States. More than a hundred dogs are entered in some of the larger contests, and money is often spent freely in furthering the sport. Some of the owners of dogs that are entered have preserves of their own, stocked with hundreds of pairs of

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[a] Upland Game Birds, 1902, p. 5. [b] Game Birds at Home, 1895, p. 17.

bobwhites. Thousands of live birds for these purposes are in demand, and at high prices. If the bobwhite could be domesticated and reared successfully in captivity for sale for this purpose, the enterprise would doubtless be highly profitable.

The cost of training a dog for the field trial is greater than that of training it for shooting. Reputable handlers ordinarily charge $100, and wealthy patrons of field trials employ high-salaried trainers, who attend to the dogs as carefully as race horses are cared for. The field trial is, in reality, a dog race. The dog that wins must be able to go like a shot, and find and point game before his antagonist comes up to him. Such an animal usually sells for a price ranging from $300 to $1,000. In one sporting paper a score of winners (pointers and setters) are advertised, which command stud fees of $25 to $50; and it has been stated on good authority that $5,000 was refused for one of these dogs.

From these facts it is apparent that the hunting of the bobwhite is a sport of considerable importance to the health and enjoyment of thousands of sportsmen, and that in various ways it can be made to contribute to the prosperity of farmers and other people who supply its needs. Every farmer has the power to secure a fair price from hunters for the surplus birds that he is willing to spare. It is believed that if suitably managed, some farms of from 500 to 1,000 acres would yield a better revenue from bobwhites than from poultry. The time is probably not far off when farmers will try to protect their game birds from injurious hawks, foxes, and human poachers as diligently as they do their hens. The sportsman is generally willing to pay several times more for the sport of shooting his birds than they bring in market, and a farm on which bobwhites are sedulously guarded and the trespass laws strictly enforced may be made to render a steady income during the hunting season.

PRESERVATION OF THE BOBWHITE.

The value of the bobwhite as a destroyer of weeds and injurious insects, as an article of food, and as an object of sport gives importance to the question of its maintenance. So assiduously is it sought by sportsmen and market hunters that under lax laws it might easily become very scarce, especially should inclement weather, as sometimes happens, greatly impede the natural increase. On the other hand, gallinaceous birds are prolific, and with proper protection the bobwhite might be readily increased to the point of abundance. West of the Mississippi it has extended its natural range, as more and more land has come under cultivation, until now it is found as far west as eastern Colorado. In the East there is considerable fluctuation in its numbers, owing to the far greater proportion of sportsmen by whom it is sought. Each fall the birds are reported scarce or plentiful according to the locality from which the report is made. Within the last few years

several projected field trials have been abandoned, or, if attempted, have failed, because of scarcity of birds. Besides natural causes, the reasons for these irregular decreases in the abundance of the birds are to be found in diversity of open seasons, shooting out of season, excessive shooting in season, and unrestricted shooting and trapping for market. Lack of uniformity in laws of adjoining States and in some cases of adjoining counties makes their observance difficult and their enforcement often out of the question. With suitable and more uniform laws well enforced there should be a regularly abundant supply of bobwhites each hunting season in every locality adapted to their presence.

No other kind of game, large or small, has been the subject of so much legislation, and as there has been little cooperation in the matter, the result is great diversity of protection. The open season varies in length from three weeks in Ohio to seven months in Mississippi; and in North Carolina, where each county has its own law, there are five counties in which the bird may be shot at any time of the year. It is gratifying to note that in 1903 the open seasons were shortened by New York, Illinois, Kansas, Texas, and Virginia. Other States, especially those of the South, should follow this example. In order that the laws may be respected, an effective system of State game officials should be established in every State where it is lacking. A number of States depend solely on county officers for enforcement of game laws; but experience has shown that without a central State organization and special game wardens, the game law is apt to be largely a dead letter. Finally, market hunting should be curtailed, or perhaps at least temporarily abolished, and modern restrictions on sale and export imposed.

Although the bobwhite is hardy, has enormous fecundity, and takes kindly to civilization, encouragement and propagation of the bird is not an easy undertaking. During the breeding season, as well as in severe winters, it has to struggle hard for existence. Mowing machines destroy its nests, crows steal its eggs, and domestic cats, as well as foxes and certain hawks, prey on its young. During the winter, especially in the northern part of its range, it is sometimes destroyed in great numbers by deep and crusted snows. The greatest need in severe weather is a food supply that will not be rendered inaccessible by a heavy snowfall. The berries of sumac, wax myrtle, and bayberry, and the hips of the wild rose furnish a palatable supply of such food. Bayberry and wax myrtle are eaten eagerly along the coast where they thrive, but sumac is generally the most important of these staples. Nine-tenths of the food of a dozen bobwhites shot in North Dakota during December consisted of the bright carmine berries of the sumac, some of the birds having eaten from 200 to 300 of them. The food supply can be improved, and owners of game preserves and others who wish to have the bobwhite as a neighbor can insure the

presence of a greater number of birds to the acre if they will adopt this means of securing them. In the Northern States buckwheat planted late will give an abundance of food for the young, growing birds. In damp situations climbing false buckwheat and smartweed yield them an excellent support that will continue well into the winter. In the South the cowpea makes a good winter supply, and millet, kafir corn, and bald barley planted late are also excellent. Hairy vetch, alfalfa, tick trefoil, Japan clover, and the hog peanut furnish excellent food for the bobwhite. Sunflower and ragweed seeds are also palatable and nutritious. Acorns, chestnuts, and beechnuts are utilized, especially by those birds that are kept in the woods by gunners. In Florida pine seeds are eaten in winter. During summer the running blackberry is an important article of food.

Suitable cover is especially important in order that the birds may escape from hawks. Thickets of rose, blackberry briers, holly, laurel, and cat brier, adjacent to the birds' feeding grounds—that is, along the edges of fields—afford the best refuge from winged enemies. Young pine woods are the safest retreat when the enemy carries a gun. If grain is provided in winter for the birds, it should be scattered along the edge of cover, so that they will not be imperiled when they take it. The birds must have, also, good roosting places. An ideal situation is a field covered with broom sedge, intermingled with briers. A good water supply is of course essential.

Experience has shown that in suitable situations the bobwhite will thrive if a chance be given it, and the friends of the bird should see that such a chance is afforded. The Audubon societies, with a total membership of 65,000 to 70,000, which cherish the bird for the pleasure it brings to eye and ear; the sportsman, who loves the whirr of its brown wings bursting from the stubble; and the farmer, whose enemies it destroys and whose resources it enriches, should work together to secure for its preservation laws adequate and generally enforced.

SEEDS, FRUITS, INSECTS, ETC., EATEN BY THE BOBWHITE.

SEEDS.—Scrub pine (*Pinus virginiana*); long-leaved pine (*P. palustris*); slender paspalum (*Paspalum setaceum*) and other paspalum species; crab grass (*Panicum sanguinale*); slender finger-grass (*P. filiforme*); barnyard grass (*P. crus-galli*); barbed panicum (*P. barbulatum*); tall smooth panicum (*P. virgatum*); spreading panicum (*P. proliferum*); witch grass (*P. capillare*); yellow foxtail grass (*Chætochloa glauca*); green foxtail grass (*C. viridis*); timothy (*Phleum pratense*); sheathed rush grass (*Sporobolus vaginæflorus*); slender spike grass (*Uniola laxa*); wild rice (*Zizania aquatica*); sedge (*Cyperus* sp.); rush (*Scirpus* sp.); tussock sedge (*Carex stricta*); skunk cabbage (*Spathyema fœtida*); swamp oak (*Quercus palustris*); white oak (*Q. alba*); live oak (*Q. virginiana*); beech (*Fagus americana*); hornbeam (*Carpinus caroliniana*); chestnut (*Castanea dentata*); sheep sorrel (*Rumex acetosella*); dock (*Rumex crispus*); persicaria (*Polygonum lapathifolium*); Pennsylvania persicaria (*P. pennsylvanicum*); smartweed (*P. hydropiper*), knotweed (*P. aviculare*); black bindweed (*P. convolvulus*); climbing false buckwheat (*P. scandens*); pigweed (*Chenopodium album*); rough pigweed (*Amaranthus retroflexus*); carpetweed (*Mollugo verticillata*); corn cockle (*Agrostemma githago*); chickweed (*Alsine media*); charlock (*Raphanus raphanistrum*); witch-hazel (*Hamamelis virginiana*); acacia (*Acacia* sp.); redbud (*Cercis canadensis*), sensitive pea (*Cassia nictitans*); partridge pea (*C. chamæcrista*); cowpea (*Vigna catjang*); garden pea (*Pisum sativum*); lima bean (*Phaseolus lunatus*); red clover (*Trifolium pratense*); white clover (*T. repens*); undetermined *Cassia* seeds; lupine (*Lupinus* sp.); trefoil (*Lotus* sp.);

psoralea (*Psoralea* sp.); locust tree (*Robinia pseudacacia*); Florida coffee (*Sesban macrocarpa*); tick trefoil (*Meibomia nudiflora*); tick trefoil (*M. grandiflora*); hairy bush clover (*Lespedeza hirta*); creeping bush clover (*L. repens*); bush clover (*L. violacea*); Japan clover (*L. striata*); vetch (*Vicia* sp.); hog peanut (*Falcata comosa*); downy milk pea (*Galactia volubilis*); prairie rhynchosia (*Rhynchosia latifolia*); trailing wild bean (*Strophostyles helvola*); pink wild bean (*S. umbellata*); cranesbill (*Geranium carolinianum*); yellow sorrel (*Oxalis stricta*); Texas croton (*Croton texensis*); three-sided mercury (*Acalypha gracilens*); spotted spurge (*Euphorbia maculata*); flowering spurge (*E. corollata*); red maple (*Acer rubrum*); box elder (*A. negundo*); jewel weed (*Impatiens* sp.); sida (*Sida spinosa*); violet (*Viola* sp.); ash (*Fraxinus* sp.); morning glory (*Ipomœa* sp.); bindweed (*Convolvulus* sp.); gromwell (*Lithospermum officinale*); corn gromwell (*L. arvense*); puccoon (*L. canescens*); vervain (*Verbena stricta*).

FRUITS.—Saw palmetto (*Sabal serrulata*); cabbage palmetto (*S. palmetto*): Solomon's seal (*Polygonatum* sp.); greenbrier (*Smilax* sp.); wax myrtle (*Myrica cerifera*); bayberry (*M. carolinensis*); red mulberry (*Morus rubra*); sassafras (*Sassafras sassafras*); thimbleberry (*Rubus occidentalis*); highbush blackberry (*R. villosus*); dewberry (*R. canadensis*); strawberry (*Fragaria* sp.); rose (*Rosa* sp.); haw (*Cratægus* sp.); apple (*Pyrus malus*); cultivated cherry (*Prunus* sp.); wild black cherry (*P. serotina*); poison ivy (*Rhus radicans*); dwarf sumac (*R. copallina*); staghorn sumac (*R. hirta*); scarlet sumac (*R. glabra*); holly (*Ilex opaca*); black alder (*I. verticillata*); climbing bittersweet (*Celastrus scandens*); frost grape (*Vitis cordifolia*); flowering dogwood (*Cornus florida*); sour gum (*Nyssa sylvatica*); checkerberry (*Gaultheria procumbens*); huckleberry (*Gaylussacia* sp.); blueberry (*Vaccinium* sp.); ground cherry (*Physalis* sp.); nightshade (*Solanum nigrum*); elder (*Sambucus canadensis*); black haw (*Viburnum prunifolium*); honeysuckle (*Lonicera* sp.); partridge berry (*Mitchella repens*); sarsaparilla (*Aralia* sp); Virginia creeper (*Parthenocissus quinquefolia*); bastard pennyroyal (*Trichostema dichotomum*); rib grass (*Plantago lanceolata*); button weed (*Diodia teres*); trumpet creeper (*Tecoma radicans*); orange hawkweed (*Hieracium aurantiacum*); marsh elder (*Iva ciliata*); great ragweed (*Ambrosia trifida*); ragweed (*A. artemisiæfolia*); everlasting (*Antennaria carpathica*); sunflower (*Helianthus annuus*); crownbeard (*Verbesina* sp.); beggar ticks (*Bidens* sp.).

INSECTS AND OTHER INVERTEBRATES.—*Beetles* (*Coleoptera*): Ground beetles (*Harpalus pennsylvanicus, H. caliginosus, Anisodactylus rusticus, A. baltimorensis, Agonoderus pallipes, Platynus extensicollis, Scarites subterraneus, Amara* sp., *Casnonia pennsylvanica*); Colorado potato beetle (*Doryphora decemlineata*); locust leaf-mining beetle (*Odontota dorsalis*); flea beetle (*Disonycha quinquevittata*); spinach flea beetles (*D. xanthomelæna, D. mellicollis, Œdionychis fimbriata*); three-lined potato beetle (*Lema trilineata*); leaf beetle (*Nodonota tristis*); grape-vine colaspis (*Colaspis brunnea*); leaf beetles (*Chrysomela pulchra, C. suturalis, Microrhopala vittata, Cryptocephalus venustus*); golden tortoise beetle (*Coptocycla bicolor*); striped cucumber beetle (*Diabrotica vittata*); twelve-spotted cucumber beetle (*D. 12-punctata*); bean-leaf beetle (*Cerotoma trifurcata*); Mexican cotton boll-weevil (*Anthonomus grandis*); Fuller's rose beetle (*Aramigus fulleri*); bill bug (*Sphenophorus parvulus*); corn bill bug (*S. zeæ*, auct.); weevils (*Centrinus* sp., *Tanymecus confertus, Chalcodermus collaris, Thecesternus humeralis*); imbricated snout beetle (*Epicærus imbricatus*); clover-leaf weevils (*Phytonomus punctatus, Sitones hispidulus*); May beetle (*Lachnosterna tristis*); leaf chafers (*Diplotaxis* sp., *Anomala* sp., *Serica* sp., *Aphonus* sp.); dung beetles (*Aphodius inquinatus, Onthophagus pennsylvanicus*); click beetles (*Melanotus communis, Drasterius elegans, Agriotes* sp., *Corymbites* sp.); histerid beetle (*Histeridæ*); darkling beetle (*Blapstinus* sp.); ladybirds (*Hippodamia parenthesis, Coccinella sanguinea, Adalia bipunctata*); squash ladybird (*Epilachna borealis*); rove beetles (*Staphylinidæ*); soldier beetle (*Chauliognathus pennsylvanicus*); red milkweed beetle (*Tetraopes tetraophthalmus*).

BUGS (*Hemiptera*).—Chinch bug (*Blissus leucopterus*); false chinch bug (*Nysius angustatus*); stink bugs (*Euschistus tristigmus; E. variolarius, Podisus* sp., *Brochymena* sp., *Nezara hilaris, Mormidea lugens, Hymenarcys nervosa, H. æqualis, Thyanta custator, Œbalus pugnax, Trichopepla semivittata, Cœnus delius, Peribalus limbolarius*); shield-backed bug (*Scutelleridæ*); tarnished plant bug (*Lygus pratensis*); negro bug (*Corimelæna* sp.); assassin bug (*Apiomerus crassipes*); bugs (*Alydus eurinus, Corizus* sp., *Euthoctha galeator*); leaf hoppers (*Deltocephalus* sp., *Proconia* sp., *Diedrocephala* sp., *Oncometopia lateralis*).

GRASSHOPPERS, ETC. (*Orthoptera*).—Cricket (*Gryllus* sp.); meadow grasshoppers (*Xiphidium* sp., *Orchelimum* sp., *Scudderia* sp.); katydid (*Microcentrum* sp.); walking stick (*Phasmidæ*); grouse locust (*Tettix* sp.); two-lined locust (*Melanoplus bivittata, M. scudderi*); red-legged grasshopper (*M. femur-rubrum*); lesser migratory locust (*M. atlanis*); Rocky Mountain locust (*M. spretus*); American locust (*Schistocerca americana*).

BUTTERFLIES, ETC. (*Lepidoptera*).—Cotton worm (*Alabama argillacea*); boll-worm (*Heliothis armiger*); striped garden caterpillar (*Mamestra legitima*); yellow bear (*Diacrisia virginica*); pyralid (*Tholeria reversalis*); purslane sphinx (*Deilephila lineata*); Southern tobacco worm (*Phlegethontius carolina*); angle-wing caterpillar (*Junonia cœnia*); angle-wing pupa (*Vanessa* sp.).

MISCELLANEOUS INSECTS.—Corn-louse ant (*Lasius* sp.); pavement ant (*Tetramorium cæspitum*); black ant (*Camponotus pennsylvanicus*); gall flies (*Cynipidæ*); ichneumon flies (*Ichneumonidæ*); insect egg parasite (*Proctotrypes* sp.); black wasp (*Tiphia inornata*); crane flies (*Tipulidæ*); May flies (*Ephemeridæ*); flesh fly (*Lucilia cæsar*); robber flies (*Asilidæ*).

MISCELLANEOUS INVERTEBRATES.—Ground spiders (*Lycosidæ*); harvest spiders (*Phalangidæ*), centipedes (*Chilopoda*); thousandlegs (*Julus* sp.); snail (*Pupa armifera*); pond snail (*Succinea avara*); crayfish (*Cambarus* sp.).

THE STATUS OF THE MEXICAN COTTON BOLL-WEEVIL IN THE UNITED STATES IN 1903.

By W. D. Hunter,
In Charge of Cotton Boll-Weevil Investigations, Division of Entomology.

INTRODUCTORY.

The boll-weevil is undoubtedly the most serious menace that the cotton planters of the South have ever been compelled to face; indeed it is doubtful if any other insect ever caused such grave fears for an agricultural industry. It was generally considered that, until the appearance of the pest in Texas, there were no apparent difficulties to prevent an increase in cotton production that would keep up with the enlarging demand of the world, until probably at least twice the present normal crop of about 10½ million bales should be produced. Now, however, in the opinion of most authorities, the weevil has made this possibility very doubtful, although the fear in many localities that cotton culture would have to be abandoned, at first entertained, has generally given way to a more hopeful feeling. Nevertheless, conservative persons who have studied the situation agree that, unless contingencies at present unexpected take place, the pest will soon cause an increase in the price of cotton throughout the world.

The difficulties in the way of controlling the boll-weevil lie as much in its habits and manner of work as in the peculiar industrial conditions involved in the production of cotton in the Southern States. The weevil lives in all stages, except the imago, within the fruit of the plant, well protected from any poisons that might be applied, and in the imago stage takes food only normally by inserting its beak within the substance of the plant; it is remarkably free from the attacks of parasites and diseases; it occupies but fourteen days for development from egg to adult, and the progeny of a single pair in a season may reach 134 millions of individuals; it adapts itself to climatic conditions to such an extent that the egg stage alone in November may occupy as much time as all the immature stages together in July and August—all these are factors that combine to make it one of the most difficult insects to control. To intensify the situation there have been, until recently, the low price of cotton and consequent small margin of profit, practically prohibiting the use of any direct means of control, and the defective tenant system of labor, so conservative as to be almost unalterably opposed to the changes in plantation practices that are now necessary in order to produce the staple profitably. Moreover, the

weevil reached Texas at what would have been, from other considerations, the most critical stage in the history of cotton production in the State. The natural fertility of the cotton lands of the State had been so great that planters had generally neglected such matters as varieties, seed selection, rotation, and fertilizers, which must eventually receive consideration in any cotton country. In general, the only seed used in planting was from the crop of the preceding year, unselected and of absolutely unknown variety. Although it is by no means true that the fertility of the cotton fields of the State had been exhausted, nevertheless on many of the older plantations the wasteful system of tillage had brought about a condition which combined with the deterioration of the seed in use to make changes necessary in order to continue the industry upon a profitable basis.

TERRITORY AFFECTED.

Up to October, 1903, the weevil had not been found outside of the State of Texas, except in the instance which occurred in August at the

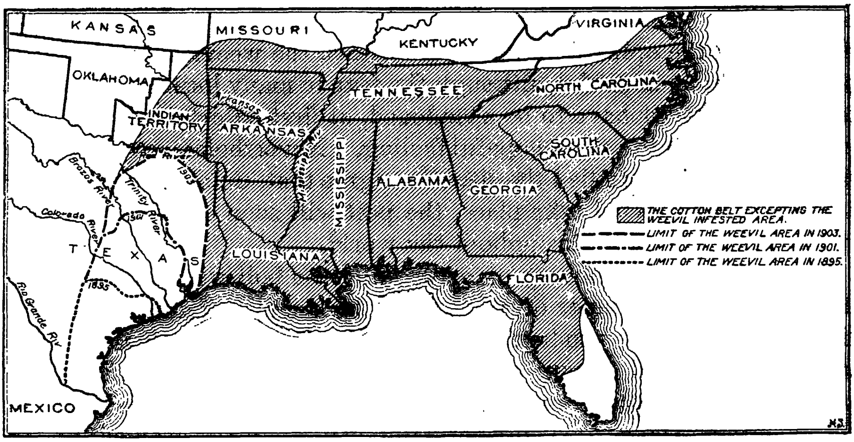

FIG. 10.—Area infested by the cotton boll-weevil.

Louisiana Sugar Experiment Station at Audubon Park, in the environs of New Orleans.[a] In that case the circumstances led the Louisiana authorities to believe that the pests were purposely placed in the cotton plats by some interested person. However this may be, the station authorities, in a prompt and well-advised manner, destroyed all the cotton of the experimental plats by gathering the fallen fruit, uprooting and burning the plants, and subsequently plowing and flooding the land after it had been thoroughly sprayed with crude petroleum. As there are no cotton fields within 10 miles of Audubon Park, and several examinations of the nearest ones by the station entomologist have failed

[a] More recently, however, December 10, 1903, the station entomologist of Louisiana, Prof. H. A. Morgan, has found two isolated points of infestation in Sabine Parish. Energetic means have been taken to eradicate these two colonies.

to reveal any weevils, it is very probable that the colony has been completely exterminated.

The map (fig. 10) shows the territory at present affected by the boll-weevil in relation to the total area devoted to cotton in the United States. The nearest approach to the Louisiana line is in the immediate vicinity of Teneha, Tex., 15 miles away. The nearest approach to Shreveport, La., is in Morris County, Tex., at a distance of about 45 miles. On the north it has been found in the vicinity of Sherman, just south of the Red River. It should be observed, however, that in the region between the latitude of Greenville and the Red River the pest is only scatteringly present, and has caused no general damage. It will require nearly two years for it to reach such numbers as will materially reduce the normal production.

AMOUNT OF DAMAGE.

Although many conditions make it very difficult to reduce to figures the damage caused by the weevil, it is believed that the following tables present a reasonably accurate estimate of the extent to which the pest affects the production of cotton within a few years subsequent to its advent. In the first table is shown a comparison of the production in ten counties in Texas in 1899, when the weevil had not yet affected the production, and in 1902, when it had multiplied to such an extent as to be found in great numbers in practically all fields. These two years were selected for the reason that they were very similar in amount and distribution of rainfall and in other essential crop conditions. In the second table is given the production during the same years in ten leading cotton counties situated so far to the north that the weevil had not affected them in either of the two years used for comparison.

Effect of the boll-weevil on the production of cotton.

[In bales of 500 pounds.]

Production of cotton in ten leading counties in Texas in 1899, when the boll-weevil was not present, and in 1902, when it was present.			Production of cotton in ten leading counties in Texas in which the boll-weevil was not present either in 1899 or 1902.		
County.	1899	1902	County.	1899	1902
Caldwell	47,473	23,133	Montague	15,064	16,981
Colorado	30,923	11,493	Cooke	11,905	11,012
Fayette	73,238	31,200	Grayson	40,871	54,087
Gonzales	44,131	25,351	Fannin	59,802	70,540
Grimes	26,541	12,135	Lamar	49,193	59,269
Lavaca	42,484	22,906	Wise	17,556	18,869
Montgomery	10,272	3,660	Denton	20,381	24,541
San Jacinto	8,826	3,014	Collin	49,077	47,241
Travis	60,078	28,382	Hunt	50,317	49,713
Wharton	27,383	12,870	Delta	24,705	26,256
Total	371,349	[a] 174,174	Total	338,871	[b] 378,612

[a] Decrease in production, 53 per cent.

[b] Increase in production, 11 per cent.

It will be seen that while between the seasons compared in the first series of counties there had been a decrease in production of 53 per cent, in the counties in the second series there had been an increase of 11 per cent. There seems good reason for supposing that the counties of the first series, were it not for the damage of the weevil, would have increased their production in about the same proportion as was the case in those of the second series. This would seem to indicate that the approximate damage caused by the insect in the infested counties should be represented by 53 per cent plus the gain in the other case, or about 64 per cent. There are two sources of possible error in these figures. One is in the possibility of a change in acreage that might not have affected the two regions alike, and the other is in the probability that the two seasons were not exactly similar. In relation to the first point, it must be stated that changes in acreage are usually the result of conditions of the market that would affect the whole State alike, and if there were any increase in these years it would probably have been very much alike in either case. In relation to the probability of an appreciable difference in the seasons, it must be stated that the two regions are close together, and that a careful examination of the records shows that the climatic conditions were remarkably alike in all important respects; but, on the other hand, it is the tendency of planters, as soon as the weevil becomes a serious menace, to devote more of their land to other crops. Accurate figures are not available, but on the whole an allowance of a reduction of acreage of this kind that would account for a 10 per cent decrease in production would be ample. It therefore seems to the writer that a figure in the neighborhood of 50 per cent represents a very fair approximate estimate of the loss. In this connection, it is interesting to note that statistics drawn from acreage and production, to which the writer referred in a former article,[a] bear out the above conclusions, and indicate that the presence of the weevil practically doubles the area of land required to produce a bale of cotton.

Upon the foregoing basis, during the present season, the weevil has caused the Texas planters a loss of about $15,000,000, and this estimate agrees substantially with the estimates made in other ways by the more conservative cotton statisticians. Many conditions of climate and plantation practice in the eastern portion of the cotton belt indicate that the weevil problem will eventually be as serious east of the Mississippi as it is in Texas now. With Mr. Richard H. Edmond's estimate that the normal cotton crop of the United States represents a value of $500,000,000, the probable ultimate damage when the pest has become spread over the entire belt would be in the neighborhood of $250,000,000 annually, provided nothing were done to check it. Nevertheless, there are conditions at work that seem to indicate that

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[a] "The present status of the Mexican cotton boll-weevil in the United States," Yearbook of the U. S. Department of Agriculture, 1902, pp. 369–380.

planters in weevil regions are gradually adopting changes in their system of producing cotton that have a tendency to avoid damage. No one who travels in southern Texas or who carefully examines the statistics pertaining to that region can fail to perceive indications that the planters will continue to produce cotton profitably. The following table shows to what extent Victoria County has continued to raise cotton since the weevil reached it, 1894, in spite of the fact that the acreage has not been increased very materially:

Cotton production in Victoria County, Tex.

[In equivalents of 500-pound bales.]

Year.	Bales.	Year.	Bales.
1894	6,895	1899	5,547
1895	4,404	1900	11,956
1896	9,796	1901	9,060
1897	7,746	1902	9,236
1898	7,006		

PLAN OF THE BOLL-WEEVIL WORK OF THE DEPARTMENT.

The work of the Department of Agriculture with the boll-weevil consists of field experiments and laboratory investigations. (Pl. XVII.) Altogether, four entomologists are engaged in the investigation in Texas and another has conducted studies in Cuba. The field work for the season of 1903 comprises considerable tracts of cotton grown in such a manner as to constitute demonstrations of the means that are necessary in order that cotton may be produced profitably in spite of the weevil. These experiment fields aggregate 558 acres, located at six different points, representing the five regions in Texas which, by reason of variation in climate and soil, constitute as many distinct cotton districts. One hundred and fifty-six acres at Victoria and Wharton together represent typical situations in the river valleys of the coast belt, where the occurrence of volunteer cotton is rather normal, and by furnishing food for the pests early in the spring presents a feature that is lacking elsewhere. Twelve acres at San Antonio represent the problem in the case of cotton grown under irrigation, where the work of the season has shown that it is particularly easy to control the pest. At Austin 100 acres are devoted to the experiments in the typical high black prairie region, which includes the most productive cotton counties in Texas. At Calvert, in the Brazos River Valley, 200 acres, the largest tract that the Department has at one point, represents the river valley region of central Texas, where the low and moist situation, presence of timber, defective labor system, and almost exclusive production of cotton, combine to make what will be the most seriously affected weevil region in the United States until the Yazoo Valley in Mississippi becomes invaded. At Hetty and Wills Point, 40 and 50 acres,

respectively, represent the river valley region of north Texas and the high prairies of that portion of the State. Representative planters at these several places undertake under contract to prepare the land and plant and care for the crop exactly in accordance with the directions of the agent in charge. This system gives the Department practically complete charge of large tracts of cotton without involving the expense of renting the land and working the crop, and it has been found to be a most satisfactory method of conducting field work upon a large scale. In these fields every expedient that has been found to be useful in avoiding damage by the weevil is being tried. These expedients include early varieties, different methods of planting, special cultivation, rotation, and fall destruction of the plants, as well as many others. The most difficult feature of work of this kind is in the interpretation of the results and in attributing to each factor in the process the effect that belongs with it. In order to assist as much as possible in this matter, wherever a field is treated in any manner out of the ordinary, another field alongside of it, to which only the ordinary attention is given, is utilized as a check.

The following plan illustrates the method of some of these experiments near Austin, Tex., upon the plantation of Mr. Jefferson Johnson. The field contains 100 acres divided into 16 blocks containing 6¼ acres each, separated by rows of Milo maize to avoid confusion in picking:

King cotton, planted early, rows 3½ feet, thorough cultivation.
King cotton, planted early, rows 3½ feet, less cultivation.
King cotton, planted early, rows 5 feet, thorough cultivation.
King cotton, planted early, rows 5 feet, less cultivation.
King cotton, planted late, rows 3½ feet, thorough cultivation.
King cotton, planted late, rows 3½ feet, less cultivation.
King cotton, planted late, rows 5 feet, thorough cultivation.
King cotton, planted late, rows 5 feet, less cultivation.
Native cotton, planted early, rows 3½ feet, thorough cultivation.
Native cotton, planted early, rows 3½ feet, less cultivation.
Native cotton, planted early, rows 5 feet, thorough cultivation.
Native cotton, planted early, rows 5 feet, less cultivation.
Native cotton, planted late, rows 3½ feet, thorough cultivation.
Native cotton, planted late, rows 3½ feet, less cultivation.
Native cotton, planted late, rows 5 feet, thorough cultivation.
Native cotton, planted late, rows 5 feet, less cultivation.

It will be seen that a typical early variety, the King, is contrasted with the ordinary cotton of the region. Each one of the plats of the King cotton serves as a check upon each of the other plats of that variety, as well as upon a plat of the same size of native cotton treated in exactly the same manner. It thus becomes possible to estimate with reasonable accuracy the effect of select seed, early planting, wide rows, and thorough cultivation.

The work of the Division of Entomology of the Department during the season of 1902 demonstrated that it is possible to produce cotton

FIG. 1.—LABORATORY AND HEADQUARTERS OF BOLL-WEEVIL INVESTIGATION, VICTORIA, TEX.

FIG. 2.—EXPERIMENTAL FIELDS IN BOLL-WEEVIL INVESTIGATIONS, CALVERT, TEX.

FIG. 1.—MIT AFIFI EGYPTIAN COTTON, WITH TWO BOLL-WEEVILS FEEDING.

FIG. 2.—AMERICAN IMMATURE BLOOM, HOLLOWED OUT BY BOLL-WEEVIL LARVA.

[Original.]

profitably in spite of the boll-weevil. The work of the season of 1903 shows this again under different conditions of climate and soil, and in addition furnishes practical demonstrations of the success of the measures recommended by the Department to planters at six different points in the State. For example, at the present writing (October 5, 1903), from a 50-acre experimental field located at Wharton a bale to the acre has already been picked. This experiment was performed upon land that had been in cotton almost continuously for twelve years; the weevil having been present for eight years. The average production in the United States has been 1 bale to 2.3 acres. The results of these experiments are to be published in full as soon as the picking of all the cotton makes it possible.

In the laboratory at Victoria every feature of the life history of the pest is being carefully investigated. The observations and experiments made here will furnish an account of the biology of the weevil at least as complete, it is believed, as that of any North American species. (Pls. XVIII–XXI.) In addition, Mr. E. A. Schwarz has spent several months of the present year in Cuba studying the manner in which natural conditions, whether of parasites, diseases, climate, or of bringing about a degree of resistance on the part of the plant, control the insect where it has existed as an enemy of the cotton plant for a much longer period than in the United States. Mr. Schwarz found what he supposes to be the original food plant of the insect in the "Algodon de Riñon" or Kidney cotton of that island. Unfortunately, however, he failed to discover any parasites at all, and did not succeed in finding any important tendency toward immunity on the part of the five distinct varieties of cotton studied. Through the interest and courtesy of Mr. Edward Ferrer, the proprietor of a large estate near Cayamas, Mr. Schwarz arranged to have the several wild varieties planted in an infested field. Mr. Ferrer has very recently reported that none of these varieties has exhibited the slightest tendency toward immunity, the squares of the native varieties being punctured as freely by the weevils as the ordinary American cotton.

PROSPECTS OF SPREAD OF THE WEEVIL.

The steady extension of the territory affected by the weevil year by year, until the northern boundary is far north of the center of cotton production in the United States, has convinced all observers that it will eventually be distributed all over the cotton belt. In ten years it has gradually advanced a distance of about 500 miles, and will undoubtedly invade new territory at about the same rate. It is not at all likely that legal restrictions of any kind would prevent or materially hinder this spread. The slowness of the progress up to the present time indicates that the principal means of spreading are natural ones, like the winds and a simple overflow from field to field, and that the artificial agencies, like transportation in seed or in other

commodities, are comparatively unimportant. Otherwise, with the extensive shipping from Texas, the pest would now be found in many other localities throughout the South. Of course, legal restrictions could be directed only against these artificial means of distribution. In the opinion of the writer, these would be of very doubtful constitutionality, expensive, and difficult to enforce. The benefits could be no more than temporary and, it is believed, would be more than counterbalanced by the damage resulting from an interference with shipping. The best that the planters in any uninfested locality can do to defer the invasion of the weevil would be merely palliative—to avoid the procuring of seed (in which weevils are frequently accidentally carried) from localities known to be infested, and also to avoid, as much as possible, the hauling of hulls and other seed products, in which the weevils are more or less likely to be found, from the mills to the vicinity of the cotton fields.

Unfortunately, it must be confessed that during the time the weevil has been in Texas it has displayed no tendency toward dying out. In south Texas it is practically as troublesome, except in so far as it is affected by changes in managing the crop, as it was in 1895, and in Mexico, where it has existed for a much longer period, it is apparently as plentiful as ever. The investigators of the Division of Entomology have made especially careful study of all of the features of the life history of the pest that will throw light upon the question whether it will not, like many other injurious species, die down and gradually become a much less important enemy of the plant than now. In this work attention has been paid to parasites and diseases, and an exhaustive study has been made by Mr. Schwarz of temperature conditions in connection with several months' work on the hibernation of the pest at Victoria; likewise, the accounts of related species, both in this country and in Europe, have been used in comparison. It is a well-known fact that many species of insects, upon reaching a new region, with an abundance of food and an absence of the conditions that might have held them measurably in check elsewhere, are stimulated to a more rapid multiplication than normal. In order as much as possible to avoid errors from this source, the laboratory of the investigation was located in the cotton portion of the southern part of the State that has been longest affected. Nevertheless, all the observations and experiments have failed to reveal factors that show any indications of causing the pest to become much less destructive than now. After ten years, during which the insect has maintained practically constant numbers, there seems but little risk in the statement that the pest will probably always be as destructive in a series of years as it has been in Texas since 1894. At the same time, planters will undoubtedly gradually adopt new methods in raising cotton, so that the damage in any given locality will not be as noticeable as it was in the beginning. Moreover, climatic conditions will undoubtedly cause temporary diminution of

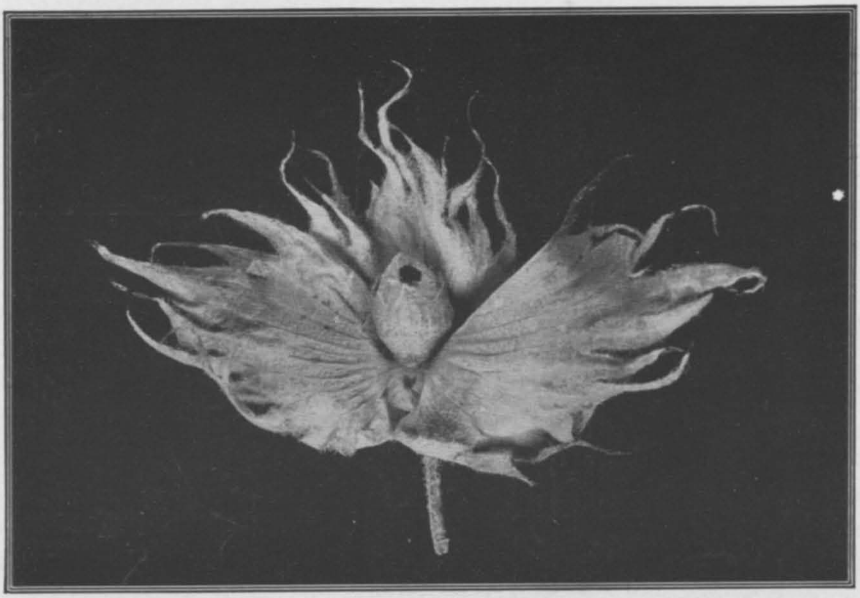

FIG. 1.—AMERICAN SQUARE, SHOWING EXIT OF ADULT BOLL-WEEVIL.

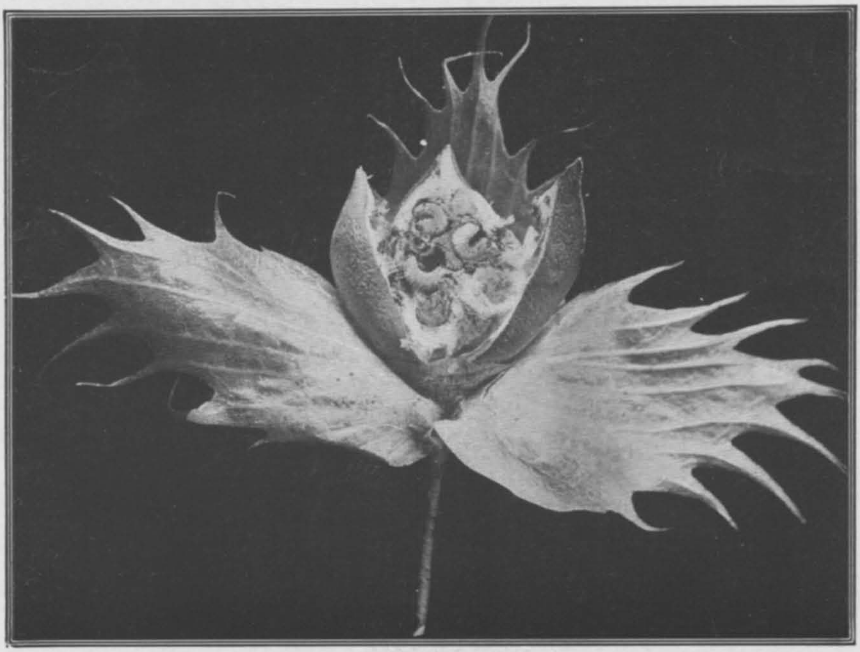

FIG. 2.—MIT AFIFI EGYPTIAN COTTON BOLL, INFESTED WITH THREE BOLL-WEEVIL LARVÆ.

[Original.]

FIG. 1.—SQUARE SHOWING FEEDING (LEFT) AND EGG (RIGHT) PUNCTURE OF BOLL-WEEVIL.

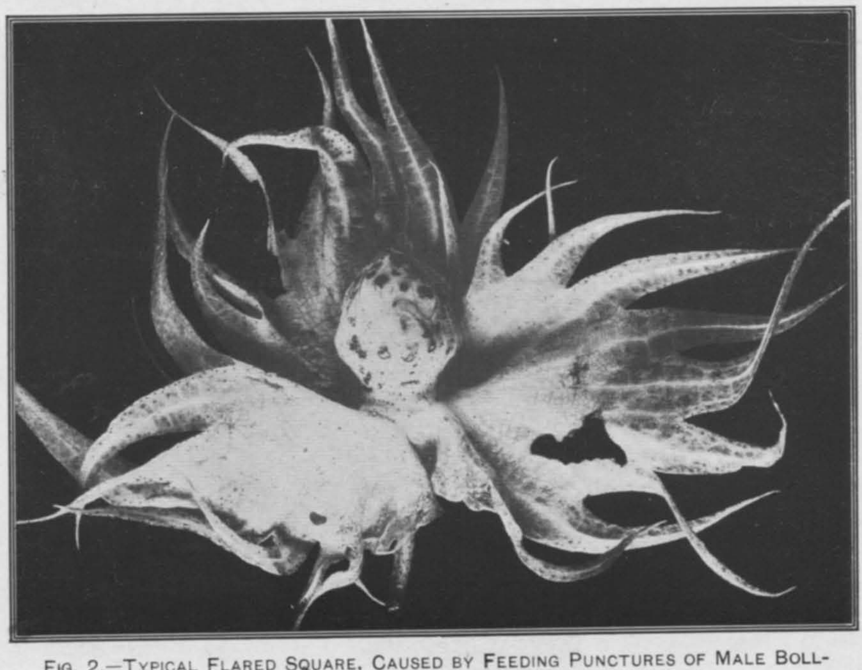

FIG. 2.—TYPICAL FLARED SQUARE, CAUSED BY FEEDING PUNCTURES OF MALE BOLL-WEEVILS, COVERED WITH THEIR EXCREMENT.

[Original.]

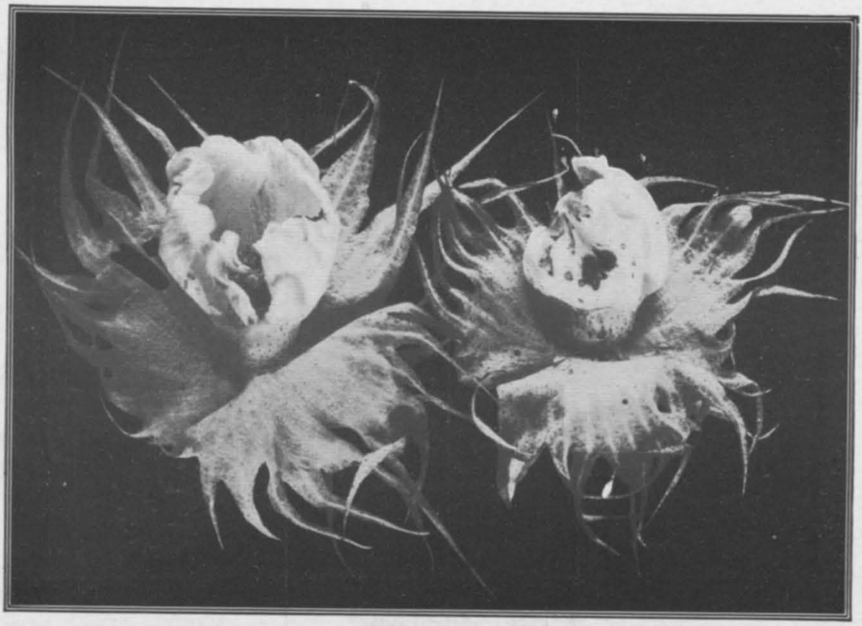

FIG. 1.—DISTORTED COTTON BLOOMS, CAUSED BY FEEDING PUNCTURES OF THE BOLL-WEEVIL IN BUD.

[Original.]

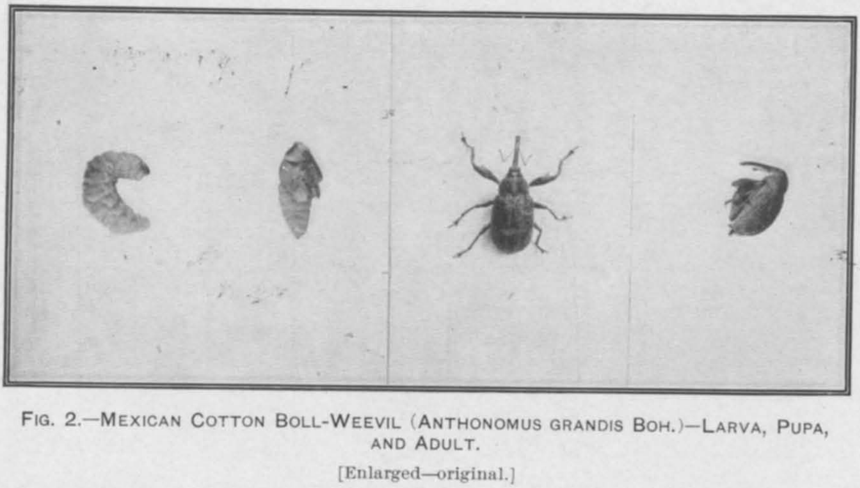

FIG. 2.—MEXICAN COTTON BOLL-WEEVIL (ANTHONOMUS GRANDIS BOH.)—LARVA, PUPA, AND ADULT.

[Enlarged—original.]

the numbers of the pest in certain localities. In Texas these conditions have given rise almost every year to the supposition on the part of some planters that the insects have died out, while the experience of the following season has invariably destroyed their hopes. In general, wet winters and dry growing seasons are unfavorable for the weevil. When a series of years involving such conditions is followed by one of less than normal rainfall, the weevils will temporarily be a comparatively unimportant factor, although their presence will undoubtedly always prevent the maturity of a fall crop. The most disastrous seasons will be those like that of 1903, in which the rainfall was excessive and the planting time unavoidably late.

WILL THE WEEVIL REACH OTHER COTTON-PRODUCING COUNTRIES?

The fact that several European governments are sending agents to this country to procure seed to be used in experiments in producing the staple in their colonies, lends some interest to speculation as to the probability that the weevil may soon be carried to remote portions of the globe. Although the insect does not, except accidentally, hibernate within the hull of the seed, every seed house attached to a gin in the infested territory harbors any that are brought in from the fields in the seed cotton. They crawl into the seed bins as they would crawl anywhere for protection. In case the seed happens to be sacked or even shipped in bulk there is nothing whatever to prevent the weevils from being carried long distances on shipboard. When thus transported the indications are that they would be able to adapt themselves successfully to climatic conditions in any region in which cotton may be grown, unless possibly in one of great elevation, like that of the Laguna district in Mexico. Although the writer is informed that the agents engaged in obtaining American seed are carefully avoiding infested portions of Texas, in view of the foregoing and of the fact that the pest is spreading rapidly, the probability that it may eventually be carried to West Africa or elsewhere is not at all remote. All danger could easily be avoided by fumigation of the seed or by leaving it sacked in storage rooms, isolated from new cotton, for a year previous to shipment.

METHODS OF CONTROLLING THE WEEVIL.

While the work of the Division of Entomology has demonstrated that no direct or specific means, such as poisons, will ever be of much avail in fighting the weevil, and that there is likewise but little hope for the artificial propagation of diseases to destroy it or for the obtaining of a variety of cotton that is in a true sense resistant, experiments with the cultural methods have been exceedingly encouraging. As a matter of fact, the success of the cultural methods has obviated the necessity of looking to direct ones. They do not involve any appreciable extra

expense in producing cotton. In general, they are simply such means as should be practiced to increase the productivity of the plants. The gradual evolution of plantation practice throughout the South would be along these lines even if the weevil were not present. By the cultural methods, the Division of Entomology has succeeded during the past season in furnishing many striking demonstrations that cotton can be produced profitably in what are now the most serious weevil regions in the United States, and individual planters may be found throughout the southern and central portions of the infested territory who have produced from one-half to one bale to the acre.

In general, the cultural methods consist of reducing the numbers of the pests in the fall by early destruction of the plants and in hastening the maturity of the crop the following spring by every means available. Fall destruction consists in plowing up and burning the plants as soon as the pests have multiplied to such an extent as to render the picking of any more cotton doubtful. Under normal conditions, this should occur some time in October. The benefits resulting from this process are threefold—many weevils are actually killed; the development of several of the so-called broods is prevented, thus further reducing the number which goes into hibernation; and the hibernating season (during which many causes bring about a considerable mortality) is lengthened. In this connection, attention may be called to the theory that the weevil might be exterminated completely by universal early fall destruction, followed by deferring the planting the next spring until May. The experiments of the Division indicate that the weevils would be able to survive that time in numbers sufficient to cause great damage. They seem to experience but little difficulty in hibernating from November until June. The fall destruction would be a good practice under any conditions, but the deferred planting would in all probability not result in as much benefit as would come from simple early planting.

In obtaining a crop that will mature before the weevils have an opportunity to do considerable damage, the most important factors are the selection of a rapid-growing variety, early planting, and thorough cultivation. The success of the planter will be in direct proportion to the extent to which he is able to combine these three essentials. Early planting of early varieties will be found to be of comparatively little avail unless followed by thorough cultivation, and in case of unavoidably delayed planting the best hope of the planter will be in persistent plowing. Spacing the plants in the row and the rows themselves, as far as the nature of the soil will permit, is also of the greatest importance, not only in hastening maturity, but also in increasing the yield.

RELATION OF PRECIPITATION TO YIELD OF CORN.

By J. WARREN SMITH.
Section Director, Weather Bureau.

INTRODUCTION.

All cultivators of the soil recognize the important relation between precipitation and crop yield. Johnson[a] said in 1870: "It is a well-recognized fact that next to temperature the water supply is the most influential factor in the production of a crop."

We believe that few people have any proper appreciation of the effect of an abundant water supply upon the ultimate yield of crops, although this subject is now receiving careful investigation. In a recent publication of the Department of Agriculture[b] describing an exhaustive investigation of many types of soil under many conditions of cultivation and wide range of yields it was found impossible to correlate the yields observed with the nutritive mineral elements in the soil or in the soil solution, which latter is the immediate source from which plants feed. From this it was concluded that on the average farm the great controlling factor in the yield (but not necessarily the quality) of crop is not the amount of plant food present, but a physical factor, the exact nature of which is yet to be determined, and this idea is made more definite by the further statement "that the actual quantity of water a soil can furnish the plant, irrespective of the percentage of water actually present in the soil, has probably a very important influence on the yield."

It is self-evident that to have water furnished to the plant in any soil in sufficient quantities there must be an abundant supply available either through actual rainfall or through irrigation; so that, other things being equal, the results of the investigations of the Bureau of Soils seem to agree with the results found in practice, namely, heavy rainfall, large yields; light rainfall, small yields. And not only this, but, in a latitude and elevation favorable for the production of crops, precipitation has first place and temperature the second.

It was with something of this thought in mind that the writer, assisted by Prof. William D. Gibbs, president of New Hampshire State College, began the preparation of the accompanying charts; yet neither

[a] How Crops Feed, p. 216. [b] Bulletin No. 22, Bureau of Soils, p. 63.

was prepared for the remarkable confirmation of their theory or the close relation between the yield of corn and the precipitation in certain definite short periods during the growth of the crop.

DATA FROM WHICH CHARTS WERE PREPARED.

Inasmuch as the greater portion of the corn produced in the United States is grown in the central part of the country, only Ohio, Indiana, Illinois, Iowa, Nebraska, Kansas, Missouri, and Kentucky are considered, both in the yield per acre and the precipitation.

As the area of greatest corn production does not include all of Ohio, Kentucky, Kansas, or Nebraska, we probably should have considered only the western parts of Ohio and Kentucky and the eastern parts of Nebraska and Kansas for both yield and rainfall. Charts 7 and 8 indicate that if this had been done there would have been an even closer relation between the curves on the preceding charts than was shown; because on charts 7 and 8, the States in the central part of the corn area, or those whose whole area is within the corn belt, show a closer relation in the curves given than do those upon either the western or the eastern edge of the corn belt.

DESCRIPTION OF CHARTS.

In all cases the precipitation is shown by the dotted line and the yield by the full line; the heavy horizontal line is the normal or average for the fifteen years for both.

CHART 1.—The full line indicates the average yield of corn per acre in bushels for the States of Ohio, Indiana, Illinois, Iowa, Nebraska, Kansas, Missouri, and Kentucky, from 1888 to 1902, inclusive. The dotted line shows the average precipitation for the month of June over the eight States and during the same period.

CHART 2.—The full line is the yield per acre, as in chart 1. The dotted line indicates the average precipitation over these States during the month of July.

CHART 3.—In this chart the yield is indicated by the full line and the precipitation for the month of August by the dotted line.

CHART 4.—"Yield" line is the same as in the above charts, and the dotted line shows the average rainfall for the months of June and July combined.

CHART 5.—The rainfall for June, July, and August is combined in the dotted line on this chart, giving the average total rainfall for those months over the eight States. The full line shows the yield.

CHART 6.—In this chart the precipitation for June and July is shown by the dotted line, as in chart 4. The "dot and dash" line indicates the lowest price of No. 2 cash corn in Chicago during the month of December of the same year, and for the same period.

CHART 7.—The yield of corn per acre is indicated by the full line and the total precipitation for June, July, and August by the dotted line, for each of the States of Ohio, Indiana, Illinois, and Iowa.

CHART 8.—This chart gives the yield per acre and precipitation during June, July, and August for the States of Nebraska, Kansas, Missouri, and Kentucky.

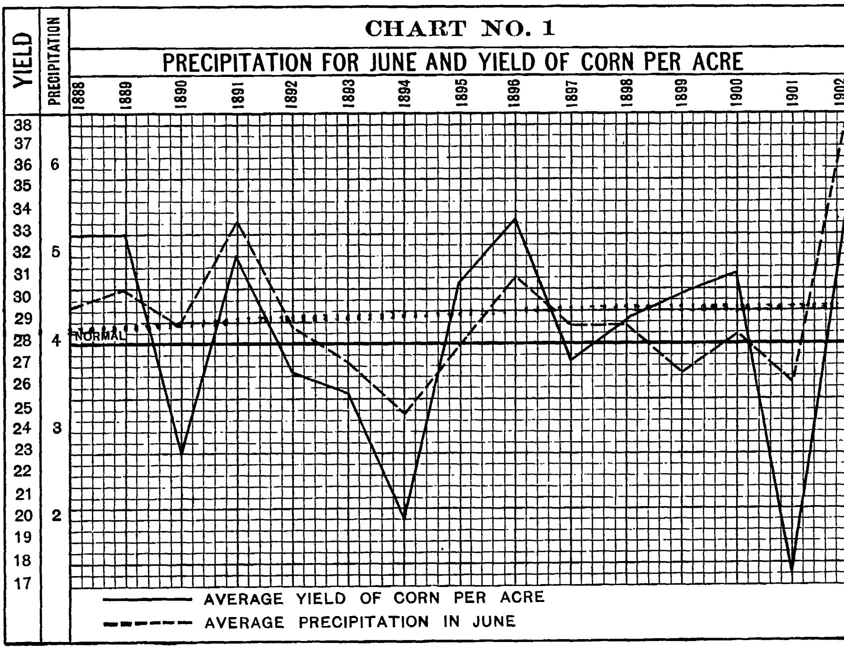

FIG. 11.—Precipitation for June and yield of corn per acre.

DISCUSSION OF CHARTS.

CHART 1.

This chart (fig. 11) shows a comparatively slight relation between the precipitation for June and the yield of corn per acre.

CHART 2.

This is probably one of the most interesting charts in the series (fig. 12). It indicates that if one knows the precipitation during the month of July over the great corn-producing district he can estimate the yield for the season very closely. There are differences, to be sure, but in the most part explainable ones. We are not sure that the statistics of yield were collected in 1888 with the care that has been exercised later. In 1891, when the yield for the district was considerably above normal, with the precipitation for July slightly below the average, there was a large June precipitation. Further, there was a very large yield in Nebraska and a moderately large yield in Kansas, Kentucky, and

Iowa, which would increase the average yield for the district. In 1896 the precipitation during July was the highest during the period, although the yield was not so large as in 1902. An examination of the meteorological records for July, 1896, however, shows that excessive showers fell across the northern part of the district. These injured corn rather than benefited it, while damage was done by drought in southern Missouri. The yield was slightly below normal in Missouri. In 1902 the yield was the greatest during the period, while the rainfall for

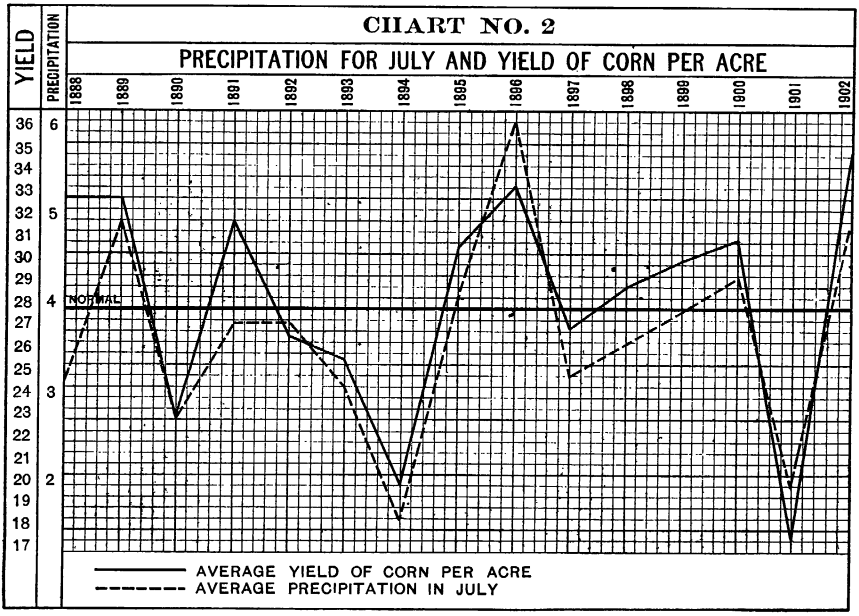

FIG. 12.—Precipitation for July and yield of corn per acre.

July was less than in 1889 or 1896. But the rainfall for June, 1902, was unusually heavy, and in connection with the abundant fall in July produced the heavy yield of that year.

CHART 3.

While the yield curve and that showing the rainfall for August agree at times, it will be readily seen that the precipitation for this month affects the general yield but little. (Fig. 13.)

CHART 4.

If the rainfall for June and July is combined, as has been done in this chart (fig. 14), the precipitation curve will follow the yield curve even more closely than the July precipitation alone, as might be expected. This is particularly true in 1891 and 1896. The agreement is not so close in 1901, however, as the rainfall for June of that year was about normal. It will be noticed that the yield was the smallest for the

period in 1901, even though the rainfall was only $2\frac{1}{2}$ inches below the normal, instead of in 1894, when the rainfall for these two months was

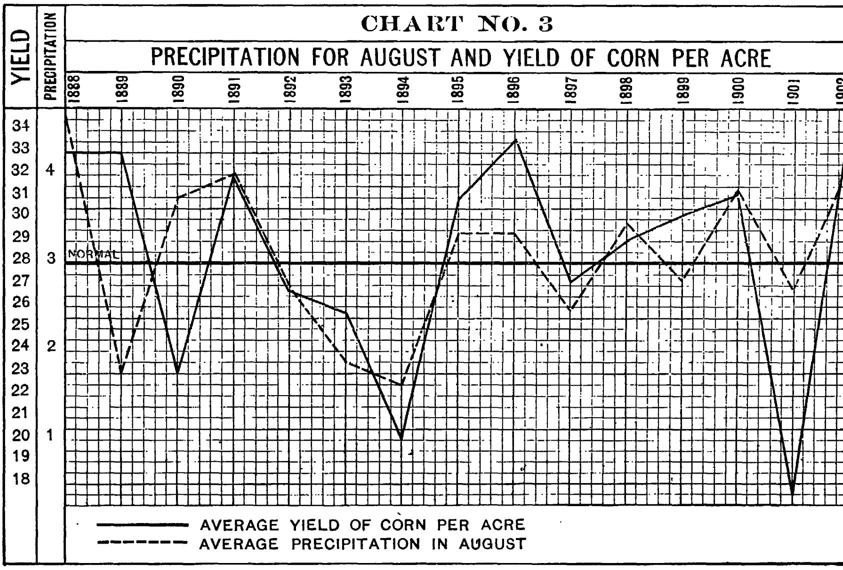

FIG. 13.—Precipitation for August and yield of corn per acre.

$3\frac{1}{4}$ inches below the normal. Charts 7 and 8 show that in 1894 the yield was particularly low only in the western States, and was but slightly

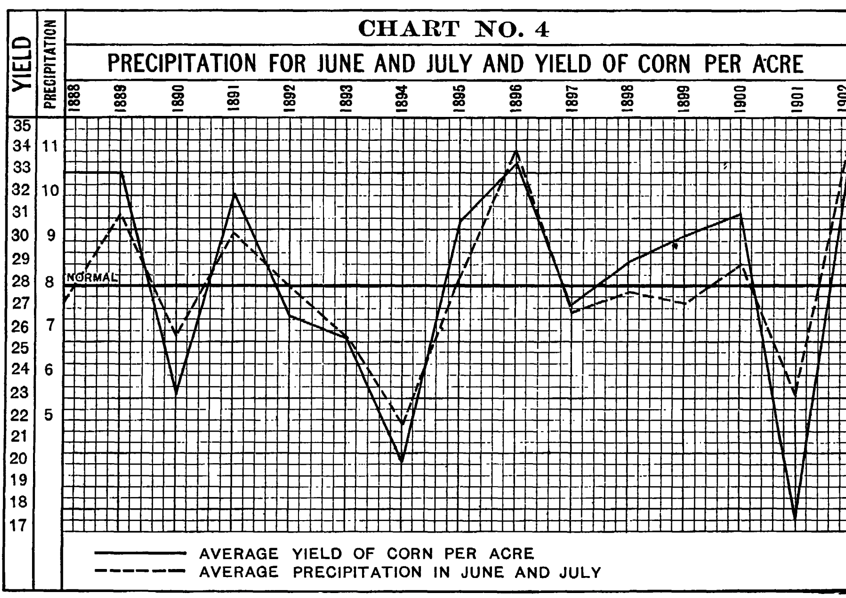

FIG. 14.—Precipitation for June and July and yield of corn per acre.

below normal in eastern districts, while in 1901 practically every State shows a small yield. The meteorological records show a severe

drought during both summers, but in 1894 the drought extended later into August, while in 1901 it began earlier in June, thus showing that it is the rainfall of June rather than that of August taken in connection with July that affects the yield most. Higher temperatures accompanied the drought in 1901, intensifying it and helping to force the yield lower than in 1894.

CHART 5.

In this chart (fig. 15) is included the rainfall for August with that for June and July. It makes the two curves agree a little more closely

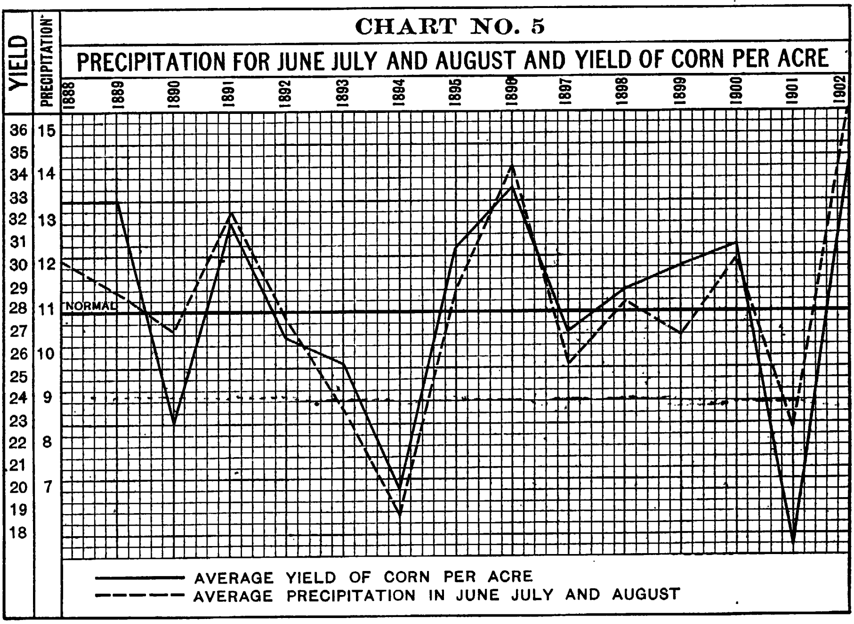

FIG. 15.—Precipitation for June, July, and August and yield of corn per acre.

in places, yet does not materially affect the results shown on either chart 2 or chart 4. It shows that the rainfall for August may or may not be included in the discussion without affecting the results to any great extent.

CHART 6.

The law of supply and demand certainly controls prices for the most part; hence, whatever affects yield affects prices. So it is only a step from the precipitation over our great corn-producing district during the vital period of its growth to the price of corn in the grain markets. One can not eliminate the factor of manipulation entirely, but it seems to be least observed in this curve of lowest cash price during December. (Fig. 16.) It is exceedingly interesting also to chart the rainfall from one season to another alongside of the price of corn on the first day of each month during the year.

CHARTS 7 AND 8.

These two charts (figs. 17 and 18) are self-explanatory, and are very interesting. The greatest yield per acre in Kansas, Nebraska, and Iowa occurred in 1889 (in Kansas far the greatest, though in Nebraska and Iowa it was only slightly greater than in 1896). In Ohio and Indiana, on the other hand, the yield was below the normal, and in Illinois and Kentucky it was about normal. The rainfall in July, 1889, was excessive in Nebraska and most of Kansas, and was abundant in most of Iowa. The fall was well distributed and in such amounts as to be very favorable to the growth of corn in those States. The rainfall was also above the normal during July in Indiana and Ohio, but it was accompanied by high winds and hail and heavy downpours, and considerable damage was done.

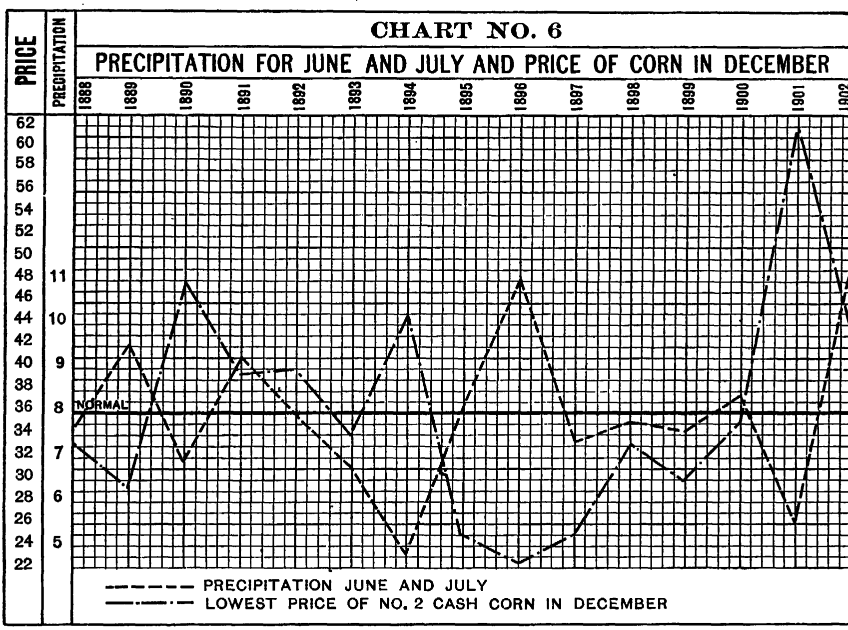

FIG. 16.—Precipitation for June and July and price of corn in December.

The year 1890 shows a uniformly low yield. It was the lowest in Ohio of all the years during the period, although the precipitation for Ohio for that summer was about the normal, as shown on the charts. The average for the State for July, however, was considerably below the normal, and in the western part of the State there was a severe drought. Many stations reported less rainfall during this month than during any other July in their history. At Dayton, Montgomery County, the total rainfall was only 0.28 inch; at Waynesville, Warren County, 0.48 inch; at North Lewisburg, Champaign County, 0.30 inch; at Wauseon, Fulton County, 0.48 inch; and at Greenville, Darke County, one of the largest corn-producing counties in Ohio, only 0.07 inch.

In 1891 the yield was somewhat above the normal in Kentucky, Kansas, and Iowa, and much above in Nebraska, agreeing very closely with

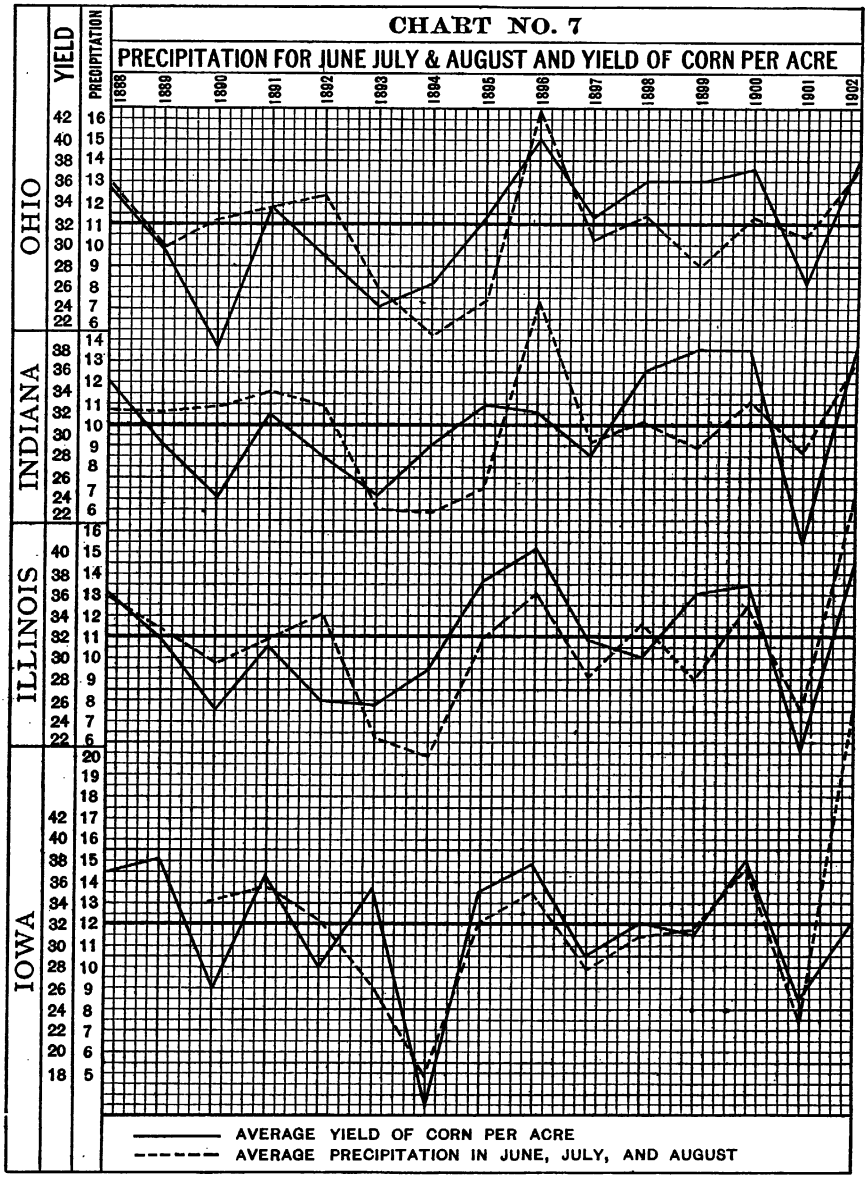

FIG. 17.—Precipitation for June, July, and August and yield of corn per acre in Ohio, Indiana, Illinois, and Iowa.

the rainfall curve. Further, the rainfall for July in Nebraska was heavy and well distributed.

In 1893 the yield for Ohio, Indiana, and Illinois was considerably below the normal. The precipitation was less than in other districts

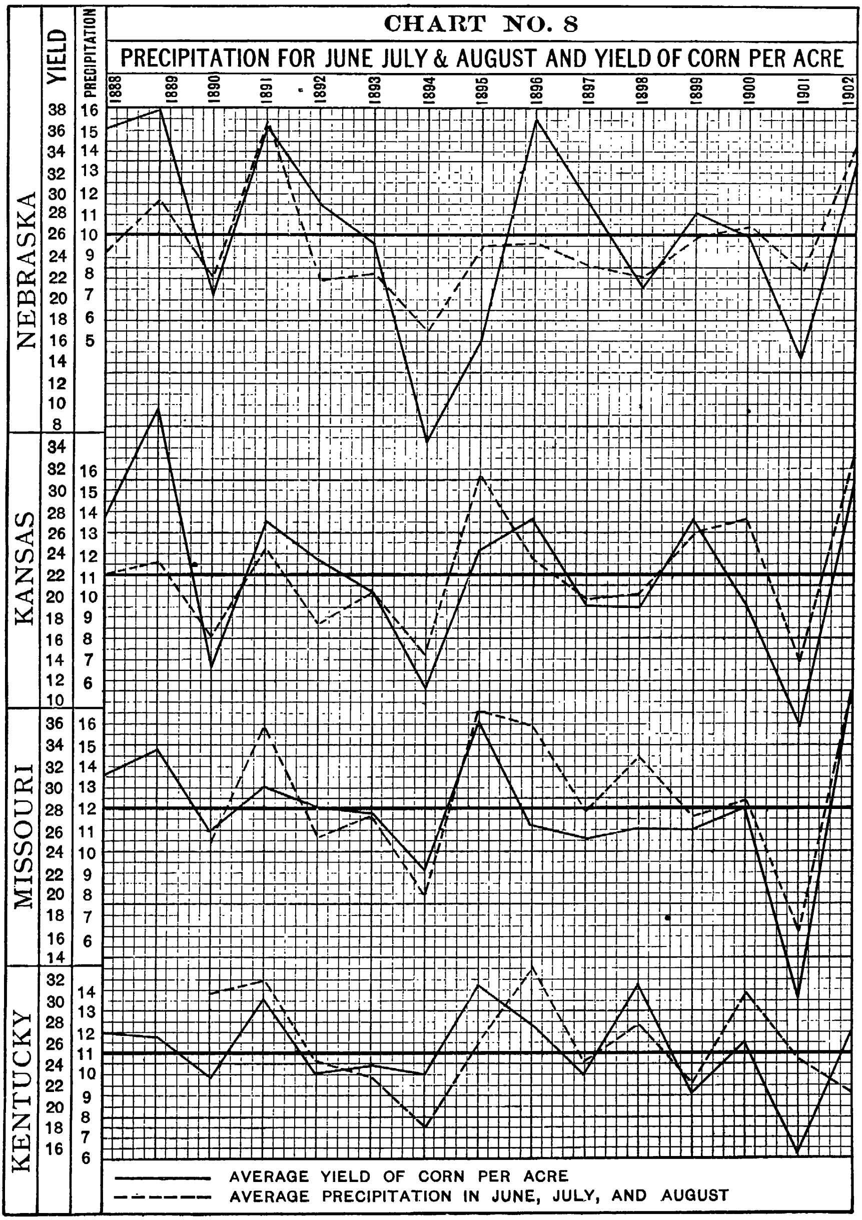

FIG. 18.—Precipitation for June, July, and August and yield of corn per acre in Nebraska, Kansas, Missouri, and Kentucky.

for the summer, and was very light during July in those States. In parts of Indiana the rainfall for July was less than 1 inch.

In 1894 the yield was generally below the normal, and was much below in Kansas, Iowa, and Nebraska—in the last two the lowest recorded in the fifteen years. In both States the precipitation for the summer was also the least recorded, while in July the average rainfall for Iowa and eastern Kansas and Nebraska was only about one-half inch. In Iowa, July, 1894, was the driest ever experienced.

In 1895 both the yield and the precipitation were highest during the fifteen years in Missouri, except in 1902. The rainfall for July of this year in Missouri was nearly 3 inches above the normal, and was well distributed. The precipitation for the summer was in excess in Kansas also, as was that for July, but the July rainfall was poorly distributed, being heavy in western counties and comparatively light in central districts.

In 1896 the yield was the greatest recorded in the period in Ohio and Illinois and was far above the normal in Nebraska. In Ohio the precipitation for the summer and that for July was the heaviest during the fifteen years. In Illinois the rainfall was not so great as in 1902, but the July rainfall was very heavy. In Nebraska, though the yield was large, the rainfall for the summer was slightly below the normal. In July, however, the rainfall was heavy in eastern counties, just where it was needed for the corn, and very light in the extreme west, thus making the average for the State only slightly above the normal, although in the great corn district it was much above. It will be noticed that in Indiana the rainfall was the greatest during the period, while the yield was but slightly above the normal. Complete data are not at hand to investigate the cause, but the rainfall was excessive during each of the summer months, particularly in July and August, probably giving too much water for the best growth and ripening.

In 1901 both the yield and the precipitation were very low, making the yield for the district the least during the fifteen years. As has been before stated, the rainfall during July of this year was everywhere below the normal, the least rainfall being in Indiana, Illinois, and Missouri, where the yields were the least.

The year 1902, on the other hand, gave the greatest yield and the heaviest summer precipitation for the district as a whole for the period. The most marked anomaly on charts 7 and 8 for this year was a very excessive rainfall in Iowa, with only a normal yield. In this State the rainfall was so excessive during July as to be damaging. Corn could not be properly worked and it was damaged on bottom lands by flooding. August was also wet and cloudy and the crop was late.

In general, charts 7 and 8 show that to draw well-defined comparisons between crop yields and summer precipitation for individual States one must take very carefully into account the geographical distribution of rainfall, the periods without rainfall, and the rate of fall.

RELATION OF COLD STORAGE TO COMMERCIAL APPLE CULTURE.

By G. Harold Powell,
Pomologist in Charge of Fruit Storage Investigations, Bureau of Plant Industry.

INTRODUCTION.

The development of fruit growing as a business distinct from the general operations of the farm has been one of the striking changes in American agriculture during the past fifty years. Early in the last century commercial orcharding was unknown in the United States. Apples and other fruits were grown in a small way about the home for family use, but there was no general interchange of fruits in the commerce of the towns and cities. But as the country grew and the facilities for transportation were extended and improved, fruit growing quickly assumed a commercial aspect, and in the last thirty years it has developed into one of the leading agricultural industries of the nation.

This rapid growth of American pomology has accompanied the rising standard of life which has led to the freer use of fruit as a staple article of food throughout the world. The Bessemer rail has spread a network of railroads over the country, and, with the modern steamship, has made commercial orcharding possible by bringing the fertile lands of the Mississippi Valley and of the Pacific coast nearer in point of time to the Eastern States, the United Kingdom, and Continental Europe than the orchards of Michigan and western New York formerly were to the cities of Boston, New York, and Philadelphia, while the recent development of the cold-storage warehouse business is adding stability and permanency to the industry by equalizing the supply of and demand for fruits, especially of the apple, by storing up the temporary oversupplies at the harvesting period and distributing them at home and abroad as needed.

THE PRESENT STATUS OF THE APPLE INDUSTRY.

The apple is preeminently the National fruit in the commercial pomology of the United States. Great geographical areas are now devoted to its cultivation, in contrast with its restricted growth a generation ago in small areas near the towns and cities. More than 200 million trees of bearing age represented the extent of the industry when the Federal census of 1900 was taken, showing an increase of

about 80 million trees during the preceding decade. In former years the industry was confined principally to the North Atlantic States, but now the center of the apple orcharding of the country is in the Mississippi Valley. Formerly the most important orchard regions were located in the cooler Northern States, but since 1870 the most rapid strides in orchard planting have been made in warmer regions like central and southern Illinois, Missouri, Arkansas, and Virginia. In 1900 the orchards of the North and South Atlantic divisions of States contained about 65 million trees of bearing age, the Western division of States had 13 million trees, while there were more than 123 million trees of bearing age in the orchards of the North and South Central divisions of States.[a] At that time seven States each had more than 10 million trees of bearing age, Missouri having more than 20 million, New York approximately 15 million, Illinois more than 13 million, Ohio nearly 13 million, Kansas and Pennsylvania each nearly 12 million, and Michigan approximately 11 million trees, while Kentucky, Indiana, Virginia, Tennessee, Arkansas, Iowa, North Carolina, and West Virginia, in the order given, contained approximately from 9 million to 5 million trees of bearing age each.

TRANSITION IN METHODS OF MARKETING THE APPLE CROP.

The apple industry is passing through a transition period in connection with the methods used in marketing the crop. As long as apple growing was only an incidental feature in the operations of the farm and the fruit did not enter generally into trade and commerce, the crop was sold by the grower directly to the merchant or to the consumer. As the industry increased and the fruit was distributed more widely, a large proportion of the apples used in the city markets was consigned to commission merchants. Within the last decade, especially since apple growing has assumed such extensive proportions and the fruit has entered into the trade and commerce of the world, the handling and marketing of the crop have been developing into a specialized business distinct from the growing of the fruit. A large proportion of the apple crop is handled at the present time by men purchasing it in the orchard, who either pack or supervise the handling of the fruit, and who have a general knowledge of the status of the apple trade at all times throughout the world, or by growers or associations of growers who have similar facilities for keeping in close

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[a] The geographical divisions of the Twelfth Census are as follows: *North Atlantic*—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania. *South Atlantic*—Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida. *North Central*—Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas. *South Central*—Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Texas, Indian Territory, Oklahoma, Arkansas. *Western*—Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Idaho, Washington, Oregon, California.

touch with the condition and the requirements of the apple trade. This revolution in the methods of handling and distributing the apple crop is still in progress, and the apple industry is not yet fully adjusted to the new conditions. The cold-storage business, by equalizing the distribution of the crop and thereby adding greater stability to the industry, is one of the important factors in this transition.

THE RELATION OF SUPPLY AND DEMAND IN THE APPLE TRADE.

In a normal season the apple trees in the United States produce from 120 to 200 million bushels of fruit. The apple crop is perishable in nature, and as it is not produced uniformly throughout the year it is not uncommon for the large markets to become oversupplied, especially during the time when the more perishable summer and fall varieties are ripening. The congestion in the apple trade has often extended into early winter, especially when the autumn months have been warm and it has been necessary to sell the winter varieties soon after harvesting to prevent unusual losses from decay. Under these conditions the fruit may not bring the cost of the freight, and enormous quantities have been sacrificed before the apples could be placed before the consumer. At the same time the supply of fruit in the smaller interior towns has been unequal to the demand, and after midwinter there generally has been an undersupply, with a strong demand for good apples in both domestic and foreign markets.

SOME OF THE CAUSES OF GLUTTED FRUIT MARKETS.

The fruit trade is subject to violent fluctuations in supply and demand on account of the perishable nature of the product. The glutted markets which have often characterized the apple trade at the height of the shipping season are due to inadequate facilities for the wide and rapid distribution of the fruit. They are the result of a condition of the industry which has made it necessary to force the crop on the market within a short space of time. These gluts are not caused by a general overproduction of apples, but rather by the faulty distribution of the crop, as an equal quantity of fruit would not supply the demand if it were distributed more widely and uniformly throughout the year.

No industry can be exempt from the effects of violent fluctuations in supply and demand unless some provision is made for equalizing the distribution of its products. The older wheat, corn, cotton, and tobacco industries have long since developed a system of warehouses, in which the temporary surplus products are stored at harvest time, and from which they are distributed to domestic and foreign markets when production ceases and the demand increases. These warehouses may be compared to a reservoir which stores a city water supply. If the whole volume of water in the reservoir were to burst suddenly upon the city the result would be disastrous and the equilibrium between the supply and the demand would be violently disturbed; but

the same quantity of water nicely balances the demands of the people when it is distributed in smaller but steady quantities throughout a longer period of time. From the earliest times it has been recognized that some provision must be made to equalize the distribution of the products of an industry if it is to grow into permanency and stability, and the apple industry is now in a transition period so far as the application to it of the warehouse system is concerned.

THE DEVELOPMENT OF THE COLD-STORAGE WAREHOUSE BUSINESS.

During the past twenty years the commercial fruit business has developed a system of warehouses cooled by mechanical methods of refrigeration. These warehouses are sometimes operated as independent fruit-storage plants, but more often the storage of the fruit is a department of a general cold-storage warehouse business. The storage of apples in mechanically cooled warehouses has developed largely since 1890, though there has been a gradual evolution in ice making and in the application of ice to the preservation of fruits and vegetables, from the simple methods of the ancients in India, who produced ice by the evaporation of water exposed to the night air in shallow, porous vessels, to the highly developed ice-making machines that cool the warehouses of the present day. As soon as it was found that apples could be kept satisfactorily in mechanically cooled warehouses, the application of the warehouse system to the commercial fruit industry was quickly perceived, and, in connection with the recent rapid development of the apple industry, warehouses for the cold storage of fruit have been constructed in nearly every large city and in many of the smaller towns in the apple belts. No complete statistics of the American warehouse business have been compiled, but it is probable that there are from 700 to 1,000 warehouses in the United States that store apples to a greater or less extent. The number of cold-storage plants is increasing rapidly at the present time.

THE MAGNITUDE OF THE APPLE-STORAGE BUSINESS.

The magnitude and development of the apple-storage business may be appreciated by reference to the following table,[a] which represents the number of barrels held in cold storage in the United States about December 1 of each year since 1898:

Apples in storage about December 1 of each year from 1898 to 1903.

	Barrels.		Barrels.
1898	800,000	1901	1,771,200
1899	1,518,750	1902	2,978,050
1900	1,226,900	1903	2,348,540

[a] Statistics furnished through the courtesy of the International Apple Shippers' Association.

Up to the present time the apple crop has been stored principally in the large cities in plants operating a general cold-storage business. Recently, however, warehouses have been constructed in small towns, especially in western New York, for the storage of fruit alone, and a few mechanically cooled plants have been built by apple growers on the farms. Cold-storage warehouses are located in the large cities principally because it is more economical to operate a general cold-storage business than a special fruit business, and also because the fruit is stored largely by apple dealers who are located in the cities, rather than by the growers of the fruit. In 1902 about 43 per cent of the apples stored in the United States were held in Chicago, New York, Boston, Philadelphia, Rochester, St. Louis, and Indianapolis.

These large warehouses are generally operated by incorporated companies. A storage charge of from 40 to 60 cents per barrel, or from 15 to 20 cents per box, is made for the season, which extends from October 1 to May 1. The storage charge may be based on a monthly rate per package if the storage extends over a part of the season only, in which case the cost is proportionally higher.

THE RELATION OF THE WAREHOUSEMAN TO THE FRUIT STORER.

The cold-storage warehouse business has developed so rapidly that the relation of the warehouseman to the man who stores the fruit, as well as the function of the warehouse in the preservation of the fruit, is not generally understood. The warehouse is supposed to supply a uniform temperature of the desired degree of cold through its rooms during the storage season. It is expected to be managed in other respects so that the deterioration of the fruit and losses from any other cause may not be reasonably attributed to a poor construction or installation of the plant, to its negligent or improper management, or to the ill-treatment of the goods within the warehouse.

If the temperature of the rooms fluctuates unduly from the degree to be maintained and the fruit is frozen to a point of injury, if it ripens with abnormal rapidity, if it is piled in certain parts of a room so that it is injured by overcooling or by heating, or if the management of the warehouse or treatment of the fruit in other respects can be shown to have been faulty or negligent, the storage house has failed to perform its proper function.

The warehouse treatment is not supposed to insure the fruit against the natural deterioration that may take place in cool temperatures. The warehouseman holds the fruit in storage as a trustee for the storer, and in that relation is bound to exercise only that degree of care and diligence in the management of the building and its contents that a man of ordinary care and prudence would exercise under the circumstances in protecting the plant and the goods if they were his private property.

CONDITIONS INFLUENCING THE KEEPING QUALITY OF APPLES.

The cold-storage house is supposed to retard the ripening processes in a temperature that will not injure the fruit in other respects, and thus to lengthen its life history. It is designed also to arrest the development of diseases with which the fruit may be affected and which cause its premature death. A fruit is a living body; its life processes go forward rapidly in high temperatures, and it soon reaches the end of its life. In low temperatures the life processes are retarded, though they progress slowly in the lowest temperature in which the fruit may be safely stored. In a similar respect the diseases which affect the fruits are due to living organisms. These multiply rapidly in high temperatures and are retarded by low temperatures. Some diseases, like the bitter-rot and apple-scab, are checked by the temperatures best adapted to the storage of the apple, while others, such as the black and blue molds, grow slowly in the lowest temperatures in which the fruit may be stored without freezing.

THE CONDITION OF THE FRUIT AND ITS KEEPING QUALITY.

The behavior of apples in a storage house depends on their condition when they enter the room. No two lots may be expected to act alike unless they are in a similar condition when stored. If one lot ripens more than another after picking, it will deteriorate sooner in the storage house. If the diseases in one lot have progressed farther than in another, the premature death of the fruit may be looked for earlier in the storage season. If the fruit has been grown under conditions that cause it to pass through its life history more quickly than the same variety grown under different conditions, it may be expected to reach the end of its life at an earlier period. The cold-storage treatment does not obliterate the differences that exist in the various lots of fruit when they enter the storage house; it rather retards, while not preventing, their normal development.

THE TEMPERATURE FOR KEEPING APPLES.

In commercial practice a temperature of 31° to 32° F. in the warehouse retards the ripening of the fruit more than a higher temperature. It also checks to a greater extent the development of diseases and of scald. When the fruit is removed from the warehouse to a warmer temperature, it remains in good condition longer when taken from a temperature of 31° to 32° F. than when removed from a higher storage temperature. In the latter case the ripening has progressed more rapidly in the warehouse, and the fruit is nearer the end of its life when removed.

Under favorable conditions winter varieties of apples may be stored satisfactorily throughout the season in a temperature of 34° to 36° F. This higher temperature is adapted to farm storage houses, or to

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NORTHERN SPY APPLES.

Five months in cold storage. The more mature fruit (upper figure) was picked two weeks later than the other.

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YORK IMPERIAL APPLE.

After five months in cold storage, revealing scald on uncolored side, showing (lower figure) that the flesh is uninjured.

warehouses in which the fruit can be placed soon after picking. If the fruit is not stored as soon as it is taken from the tree, and the temperature averages above 60° F., its ripening processes are greatly accelerated. Under these conditions a storage temperature of 34° to 36° F. does not check the ripening so quickly or to so great an extent as one at about the point of freezing, and the lower storage temperature is necessary to overcome the effect of the abuses to which the fruit has been subjected.

THE TIME TO PICK APPLES FOR COLD STORAGE.

The ideal apple for keeping in cold storage is fully grown and highly colored, but still hard when picked from the tree. In this condition it has developed the most attractive style and finest quality and has attained the highest market value. An apple that is picked prematurely appears to ripen more rapidly than fruit picked in a more mature condition. Immature fruit deteriorates as quickly as or even more quickly than fruit that has reached a higher degree of maturity on the tree. The immature fruit is likely to lose in firmness in the warehouse and it is more susceptible to the development of scald.

When the apple is handled in large commercial quantities it is not always practicable to allow the fruit to reach the ideal degree of maturity before it is harvested. The growing scarcity of labor in many parts of the country, the difficulty that is often experienced in securing cars for the transportation of the apples, and the frequent congestions in the freight traffic at the railway terminals have made it necessary to begin the picking of the crop relatively early in the season. On the other hand, a good deal of the fruit is picked prematurely under the erroneous impression that the keeping quality is improved when handled and stored in this condition. The Northern Spy apples in Pl. XXII represent fruit at different stages of ripeness. The more highly colored fruit in the upper figure of Pl. XXII has better keeping quality and is superior in every respect to the apple shown below it.

SUGGESTIONS FOR IMPROVING THE COLOR OF APPLES.

The color of apples may be heightened by cultural practices that tend to mature the fruit relatively early in the season. If the orchards are in tillage and cover crops have an excess of nitrogenous fertilizers, and the trees are sprayed, the increased productiveness of the soil and the added vigor of the trees keep them growing late in the season. These cultural conditions enlarge the leaf surface of the trees, and the fruit is shaded to a greater degree. Stopping the tillage early in the season, seeding the land to a cover crop to absorb the moisture and to take up the available plant food, and pruning the trees vigorously to let in the sunlight usually increase the color of the fruit; or

it may be accomplished, when necessary, by putting the orchard temporarily in sod. The color is believed to be improved also by the application of potash fertilizers.

The apples on a tree differ widely in the degree of maturity attained at a given time, just as is the case with peaches or plums or pears in a tree top. The fruit on the upper and outer branches ripens in advance of that on the shaded interior branches. It is impossible to secure uniformity in maturity when the entire product of a tree is picked at one time, as apples in different stages of ripeness are mixed indiscriminately together. The greatest uniformity in this respect is attained when the trees are picked over two or three times, taking the apples at each picking that have attained the desired size and color.

THE APPLE SCALD.

Apple scald is the cause of serious losses in many varieties of cold-storage apples. This difficulty develops toward the end of the storage season when the fruit approaches the end of its life, or it may appear early in lots of apples that have ripened considerably between the time of picking and of storing the fruit. The scald appears as a brownish discoloration of the uncolored portions of the fruit, that is, on the side developed in the shade. The appearance of the scald and its position on the fruit are shown in the York Imperial apple in Pl. XXIII. An apple picked prematurely is more susceptible to this trouble than one that has developed the highest degree of color before picking. In fact, highly colored apples of a variety that usually scald badly seldom develop the trouble. This phase of the subject is illustrated by the Winesap apples shown in Pl. XXIV. Apples picked when partly colored or in the condition shown in the upper figure of this plate developed 33 per cent of scald in March when stored in a temperature of 32° F. The more highly colored fruit, represented by the lower figure, which was picked from the same trees two weeks later in the season, and stored in the same room, developed at the same time only two-tenths of 1 per cent of scald.

As the scald normally appears late in the life of the fruit, a storage temperature of 31° to 32° F. retards its development more than a higher temperature; and as a higher temperature hastens the life processes, an apple that is free from scald when removed from storage late in the season may develop the trouble quickly if it is taken into a warm temperature.

All varieties are not equally susceptible. The York Imperial, Grimes *Golden*, Rhode Island *Greening*, Wagener, Huntsman, and Lankford are among those most likely to develop the trouble, though late in the season it is serious on poorly colored Baldwin, Ben Davis, Winesap, and Yellow Newtown apples, as well as on many other sorts.

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WINESAP APPLES.

After five months in cold storage, showing scald on immature fruit (upper figure) with highly colored fruit uninjured.

THE NATURE OF SCALD.—The character of scald is not well understood. It is not the result of bacteria or fungi which grow in the fruit and cause the common fruit rots, and it is not transmitted from one apple to another. It appears to be due to the normal oxidizing ferments in the fruit, which cause the premature death of the cells of the apple just beneath the skin. These cells die and finally turn brown, producing the characteristic discoloration of the skin. The trouble does not extend deeply into the flesh of the apple. Its surface nature is shown in the York Imperial apple and a cross section of the same fruit illustrated in Pl. XXIII.

THE PREVENTION OF SCALD.—With the present knowledge of scald its control seems to depend upon cultural conditions and on proper methods of handling the fruit. It is necessary to grow highly colored fruit in order to reduce the susceptibility to the trouble, and it is of primary importance to store it quickly after picking or to ship it under conditions that retard the ripening processes. If the fruit is then stored in a temperature of about 32° F., and the varieties that are likely to develop the trouble are removed from storage relatively early in the season before the scald appears, and if after removal the fruit is kept as cool as possible, the losses that occur annually from apple scald may be materially reduced.

THE IMPORTANCE OF STORING APPLES PROMPTLY AFTER PICKING.

A large proportion of the difficulties in the cold storage of apples is the result of delaying the storage of the fruit after it is picked. The apple ripens more rapidly when picked than it does when hanging on the tree and maturing in the same temperature. The diseases with which the fruit is affected appear to develop more rapidly when storage is delayed. If the weather at the harvest time is warm—that is, if the temperature averages above 60° F.—the fruit matures and the diseases grow with unusual rapidity. On the other hand, if the weather at this time is cool, the ripening progresses more slowly and the diseases may not increase in severity. The ripening that occurs during the period of delay between picking and storing shortens to that extent the life of the fruit in the storage house. Keeping the apples in piles or packages in the orchard before storing, as shown in Pl. XXV, or delays in transit or at the warehouse before they are placed in storage, therefore, cause the fruit to ripen and diseases to spread, and the apples may already have commenced deteriorating when they enter the warehouse.

The Rhode Island *Greening* apples in Pl. XXVI show the difference in maturity of fruit stored soon after picking and similar fruit stored after a delay of from two to three weeks. The keeping quality in the apple represented in the lower figure has been ruined by the delay in placing it in storage. The importance of storing fruit immediately after picking is, therefore, greatest in the warmer apple belts of the

country, though it is equally important in the northern apple-growing sections when the autumn months are unusually warm.

Advantages of a local storage house.—In handling the apple for cold storage the ideal is reached when the fruit can be taken directly from the tree to the warehouse. So far as the fruit is concerned, a similar condition is approached when it is shipped to a distant warehouse in refrigerator cars, or the ideal is attained in those sections or seasons in which the picking and handling of the crop occur in cool weather. It may not be practicable for the apple dealer who is located in a distant city to store his fruit in warehouses situated near the orchards, nor is the local warehouse advisable in sections where there are inadequate facilities for transporting the fruit to distant markets during the winter. As a general rule, it is to the mutual interest of the owner and the warehouseman that the fruit be stored where it can be watched carefully throughout the season by the owner, as the warehouseman is responsible only for the proper management of the building and its contents, and not for the ultimate condition of the fruit.

The local warehouse is especially favorable to the apple grower who stores his own fruit and who is not located near a large city warehouse. It is also adapted to apple dealers in cities who have permanent representatives near the orchards. In those sections in which the fruit is likely to ripen in warm weather, like the warmer apple regions of the Mississippi Valley and the Allegheny Mountain districts, the grower is frequently forced to sell his apples in the local market or to a dealer at a low price. If the weather is unusually warm the fruit is likely to arrive in the markets in bad condition, and the apple trade soon becomes demoralized. On the other hand, if the fruit is shipped to a distant storage house and the packing, shipping, or handling is delayed, its storage quality has been seriously impaired before it reaches the warehouse.

A system of warehouses located in the orchards and managed by growers, or operated by companies in near-by towns, would reduce some of the difficulties with which the growers in the warmer apple belts have to contend, and would thereby give greater stability to the industry in those sections. There can be no question, from the standpoint of the keeping of the fruit, of the advantage of a warehouse located near the orchard, but its usefulness to the business as a whole depends not on the keeping quality of the fruit alone, but on the larger question of its adaptability to the present requirements of the apple trade.

INFLUENCE OF ENVIRONMENT ON KEEPING QUALITY.

The same variety of apple may vary widely in keeping quality when grown under different conditions. The apple is affected by its geographical environment, by the type of soil, by the condition of

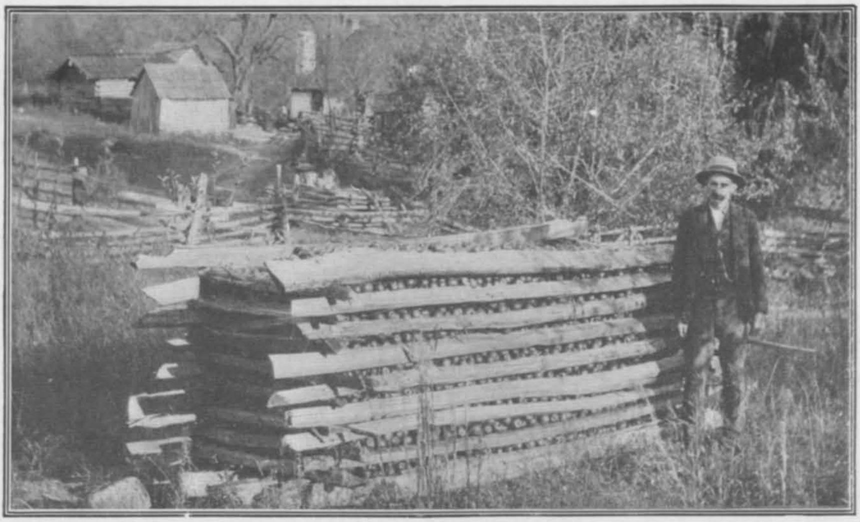

FIG. 1.—STORING APPLES IN THE FIELD, A PRACTICE COMMON IN THE ALLEGHENY MOUNTAIN DISTRICT.

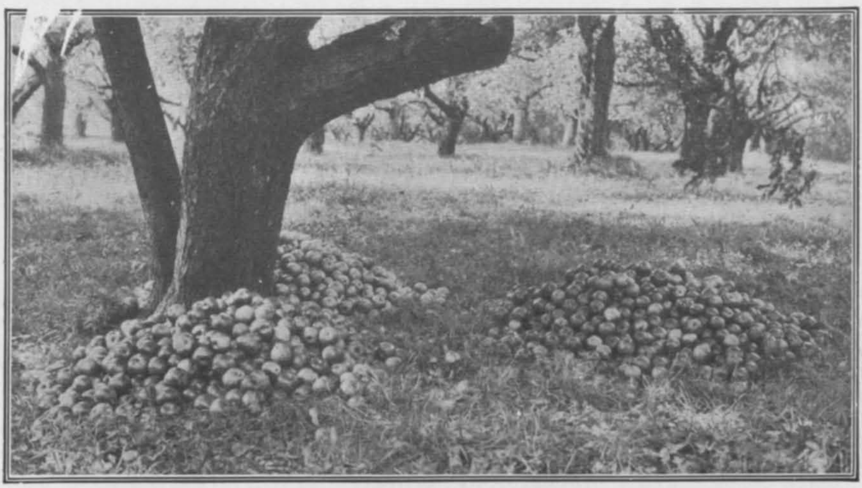

FIG. 2.—ALLOWING APPLES TO REMAIN IN PILES IN THE ORCHARD, A PRACTICE COMMON IN MANY SECTIONS.

DELAYING THE STORAGE OF APPLES.

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RHODE ISLAND GREENING APPLES.

Showing condition of fruit when stored soon after picking (upper figure) and after a delay of two or three weeks.

FIG. 1.—APPLES STORED IN BOXES, A PACKAGE ESPECIALLY DESIRABLE FOR TENDER VARIETIES.

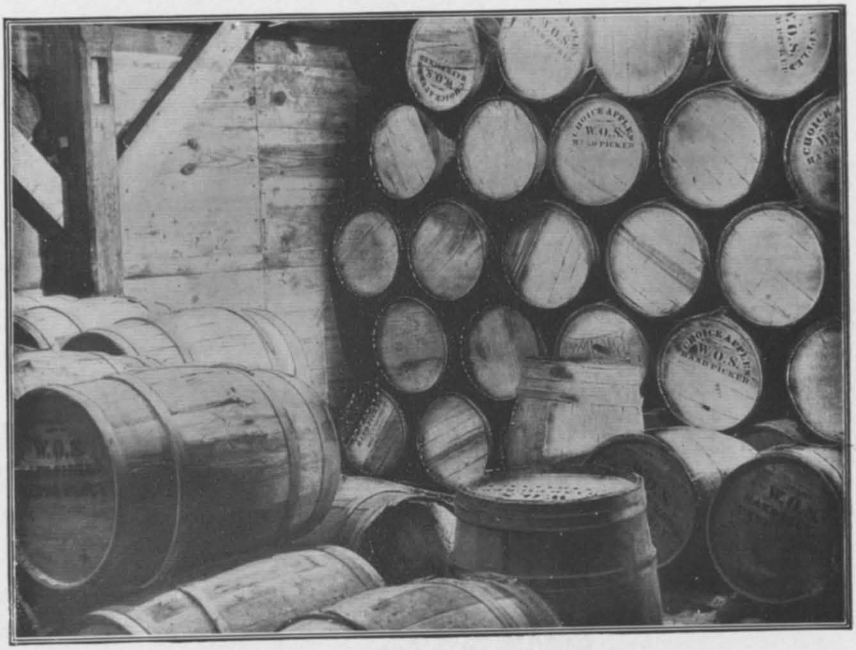

FIG. 2.—APPLES STORED IN BARRELS, THE PACKAGE COMMONLY USED.

APPLE STORAGE PACKAGES.

the trees, and by other factors connected with its production. It is probably safe to lay down the general principle that an environment which causes the fruit to grow with unusual rapidity causes it also to pass relatively faster through its life history after the fruit is picked. Apples grown on low, rich land or on young trees are abnormally large and are likely to deteriorate sooner than fruit of the same variety from older trees or a more congenial soil. Fruit stimulated by nitrogenous fertilizers in orchards in which the water-holding power of the soil has been largely increased by the incorporation of vegetable matter is often inferior in keeping quality. Similarly, apples produced on quick-acting, sandy soils and on the strong new lands in some of the newer apple-growing regions are apt to reach the end of their life relatively early in the season. The grower should recognize the fact that the apple is profoundly modified by its environment, and that the inherent differences in each lot are not eliminated by storage treatment. It should not be expected that the different lots of the same variety grown in widely different sections or under different cultural conditions will act alike in the storage room; rather the handling of the apples should be governed by the nature of the fruit itself.

INFLUENCE OF COLD STORAGE ON COMMERCIAL VALUE OF VARIETIES.

Cold storage is increasing the commercial value of many tender but otherwise desirable varieties which formerly had to be sold soon after picking. The season of the late summer and fall sorts, like Gravenstein, Williams, Alexander, Oldenburg (Syn. *Duchess*), Maiden Blush, and Fall Pippin, may be extended a month or six weeks if the condition of the apple trade warrants the storage of these varieties. Usually it is not advisable to store the quick-ripening summer and fall varieties except to relieve a congested market or to bridge over the season until the early winter sorts are fit to use. Early varieties lose their quality in storage relatively sooner than later kinds, and as the weather is likely to be warm when they are removed from storage, the fruit breaks down quickly. If the condition of the apple trade makes it advisable to store the early kinds they may be handled to best advantage when the fruit is well matured and stored soon after picking in well-ventilated rooms in a temperature of about 32° F. It is advisable to pack the fruit in packages of not over a bushel in capacity, as a larger package, like the barrel, does not radiate its heat when stored quickly enough to check the ripening of the fruit. (Pl. XXVII.)

The value of some of the early winter varieties, like Wealthy, Grimes *Golden*, Jonathan, and McIntosh, has been greatly increased by cold storage. Formerly these sorts had to be sold soon after picking to prevent loss from decay. Now they may be stored until

midwinter, or even later, and thereby add to the list of varieties of high quality obtainable during that period. The cold-storage industry has therefore increased the use of some varieties of high grade that formerly had to be planted in restricted quantities. It has also made it possible to grow these varieties in warmer localities than formerly. They may be stored in local warehouses, or with the refrigerator car near at hand they may be shipped safely to a distant warehouse and distributed later in the season.

INFLUENCE OF COLD STORAGE ON THE APPLE TRADE.

The cold-storage warehouse industry in its broadest economic relation is equalizing the distribution of the apple crop throughout the season, and equalizing the price as well. Like other warehouse systems, it must ultimately add greater stability to the supply and demand and materially benefit the producer and the consumer. The producer will reap the benefit of a steadier condition in the apple trade and of more uniform prices. The consumer will realize the advantages of a more uniform supply of apples throughout the year at even prices.

There is some danger that the cold-storage warehouse business may be developed too rapidly for the present needs of the apple trade. It is possible that the quantity of fruit stored in a given year will be so large that the prices will not reach a paying level during the winter and spring months. This condition was confronted in 1902, when a large proportion of the stored fruit was poor in quality. At that time it was estimated that there were more than 1,000,000 barrels of apples held in common storage about December 1, in addition to 3,000,000 barrels held in cold storage. The markets were full of the common-storage stock during the winter months, and the poor grades, as well as the better fruit in the warehouses, were held until spring, when the apples had to be forced on the market before the advent of warm weather. The result was a temporary oversupply and low prices at a season when fruit usually brings the highest returns. The apple-warehouse business is still too young to have adjusted itself thoroughly to the requirements of the trade. It is now at the threshold of its development, but just as the laws of supply and demand will ultimately define the extent and stability of the apple industry, so too the same laws will finally adjust the relations of the cold-storage warehouse to that business.

INFLUENCE OF COLD STORAGE IN EXTENDING APPLE MARKETS.

Cold storage is having an important influence in extending the apple markets both at home and abroad. The delicate summer and fall varieties may now be shipped to distant domestic and foreign markets in refrigerator cars or in refrigerated compartments on shipboard. Cold storage has become an important factor in the present

rapid development of the export trade in apples by lengthening the season of distribution. From the fiscal year 1893 to 1896, inclusive, an average of 78,907 barrels per year was exported from the United States between the 1st of January and the 1st of June, or an average of 17.9 per cent of the exports of each fiscal year. During the most active period in the development of the cold-storage business, or from 1897 to 1903, an average of 240,688 barrels per year, or 25.9 per cent of the exports of each fiscal year, were forwarded during the same months—an annual increase in that time of 8 per cent. From 1893 to 1896, inclusive, 4.5 per cent of the exports of the year were forwarded between March 1 and June 1. In the fiscal years 1897 to 1903, 8.3 per cent were forwarded during the corresponding period. If the fruit has been properly handled between the orchard and the warehouse, as well as in the warehouse, the late-keeping varieties can be withdrawn and exported in common storage in well-ventilated boats during the early spring, or in refrigerated compartments as late as the middle or last of May.

In this connection, it should be remembered that the export trade in apples is increasing rapidly, and that American fruit is as yet known in but few of the European markets. The export trade has increased from an average annual export of 99,316 barrels during the decade from 1860 to 1870 to an annual average of 575,548 barrels during the decade from 1890 to 1900. In the fiscal year 1903 the exports amounted to 1,655,247 barrels, and in 1904 the shipments will be greatly increased. Yet, so insignificant has been the development of the export trade to the continent of Europe that less than 20 per cent of the apple exports from the United States in the fiscal year 1902 were used outside of the United Kingdom.

INFLUENCE OF COLD STORAGE ON THE STANDARD OF FRUIT GROWING.

The cold-storage industry is one of the important influences in raising the standard of American fruit growing. There is an increasing demand on the part of the consumer for fruit of higher quality, of more attractive appearance, and of better physical condition. The early methods of handling the apple crop, whereby the fruit was roughly treated, poorly packed, and improperly preserved, do not satisfy the present demands of the warehouse business or of the more exacting consumer. The cold-storage industry is emphasizing, more than any other factor in the apple trade, the need of well grown, well graded, and carefully handled fruit for successful storage operations. Poorly grown apples, or fruit that is badly graded and roughly handled in the orchard or in transit, deteriorates quickly in the warehouse and causes dissatisfaction on the part of the consumer. Apple dealers are beginning to realize these general principles, and in the selection of storage supplies are already discriminating between

the orchardist who gives careful attention to the tillage, spraying, pruning, and fertilizing of the orchard, and the fruit grower who neglects the trees and handles the fruit improperly.

Until recently there has been little effort on the part of investigators to study the life history of the apple after it has been severed from the tree. Investigation has ceased to a large extent with the production of the crop, and the problems connected with its handling and marketing have been considered as being of a commercial rather than of a scientific character. In the last few years, however, considerable attention has been given to the chemistry and physiology of the apple from its earliest growth to old age and decay, and in this phase of the subject the influences of the conditions of growth and of the methods of handling the fruit after it is picked, including its treatment in warehouses in cold temperatures, have formed an important part of the investigations. The effect of this careful work in connection with the practical experience of warehousemen is to force better methods of picking, grading, packing, and shipping on the grower, the dealer, and the transportation companies. The cold-storage warehousing business and its exact requirements constitute one of the great educational factors in improving the American fruit industry.

PREPARING LAND FOR IRRIGATION.

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INTRODUCTION.

In order that the best crop may be grown by irrigation, a uniform wetting of the soil is necessary, and soil can be wet uniformly only when it is smooth. It is not meant by this that it must be level, but only that it must have a smooth surface, so that water can be made to run all over it, and that there shall be no low places in which the water can collect and stand. Land to be irrigated may have uniform slopes in one direction or it may be rolling, but if properly smoothed it can be uniformly wet by a proper location of the ditches carrying the water to all parts of the fields. An ideal field or farm for irrigation is one which has a smooth surface and a very gentle slope in one or two directions; but lands so nearly level and with such regular slopes are found only in river bottoms, and are not common. Even where lands are nearly level they almost never have a perfectly smooth surface. It may, therefore, be said that practically no lands are ready for irrigation without some previous preparation other than plowing.

The irrigated lands of the arid region and those that are irrigable are generally nearly level, with light sandy or ashy soils, and are commonly covered with a more or less dense growth of sagebrush. High winds are also characteristic of the region. The result is a drifting of the light soils, making hollows in unprotected places and small hills from a few inches to a few feet high, where the wind is broken by brush or any other obstruction. Pl. XXVIII, fig. 1, shows such a sand drift on a generally level plain in the vicinity of Imperial, Cal. The lands are also washed by the torrential rains which sometimes occur, making gullies with higher grounds between. The preparation of such land for irrigation includes the removal of the sagebrush, the smoothing and sometimes the leveling of the surface, and the laying out and constructing of ditches to carry water to all parts of it.

REMOVING SAGEBRUSH.

Pl. XXVIII, fig. 2, shows a sagebrush plain such as is common to the greater part of the arid region. The first step in preparing such land for irrigation is the removal of this brush. This is not generally very

hard, since the roots are near the surface and the soil is light and loose. If the brush is not too large it can be plowed out in the spring when the soil is moist and the roots, being full of sap, are easy to cut. When this can be done, the brush, after being cut with the plow, is raked into windrows and burned. The brush contains an oil which makes it burn readily even if just cut.

When the brush can not be plowed out it is sometimes grubbed out by hand with a mattock. It is estimated that one man can grub about 1 acre a day, and the cost would, therefore, be about $1.50 per acre, the usual wage of farm labor per day. The work of grubbing can be greatly reduced by the use of a railroad rail. A team is hitched to each end of the rail and it is dragged over the field, thus breaking down or dragging out the brush. Going over a strip twice, once in each direction, will usually loosen most of the brush, and the work of grubbing will be greatly reduced. A rail is sometimes bent in the form of a V and the base is often notched, so that it will catch the brush better and drag out more of it.

Sagebrush will not live in wet soil, and where water is abundant and a year can be given to removing the brush it is sometimes killed by flooding, after which it can be removed more easily. A method sometimes followed in Utah is to flood the land, killing the sage or checking its growth and increasing the growth of weeds and grass. The water is then shut off, and when the weeds and grass have dried the whole is burned off.

The estimates from a number of localities of the cost of removing sage run from $1.50 to $3 per acre, including grubbing, raking, and burning. Probably the average of these, $2.25 per acre, fairly represents the general cost.

REMOVING STONES.

In many sections of the West the land is covered with bowlders, some of which must be removed before the land can be leveled or irrigated. A report from Reno, Nev., states that in that vicinity the cost of removing stones sometimes runs as high as $25 to $30 per acre, but so large an expense is not common.

SMOOTHING AND LEVELING LAND.

The necessity for smoothing the surface of land has already been pointed out. It is the universal testimony of farmers in the irrigated sections that this smoothing should be very carefully done before the land is planted to any crop, as the saving of time in applying water and the improvement of the crops will much more than repay the extra labor and expense of doing the work thoroughly in the beginning. If land is not thoroughly smoothed, water will not flow over it readily,

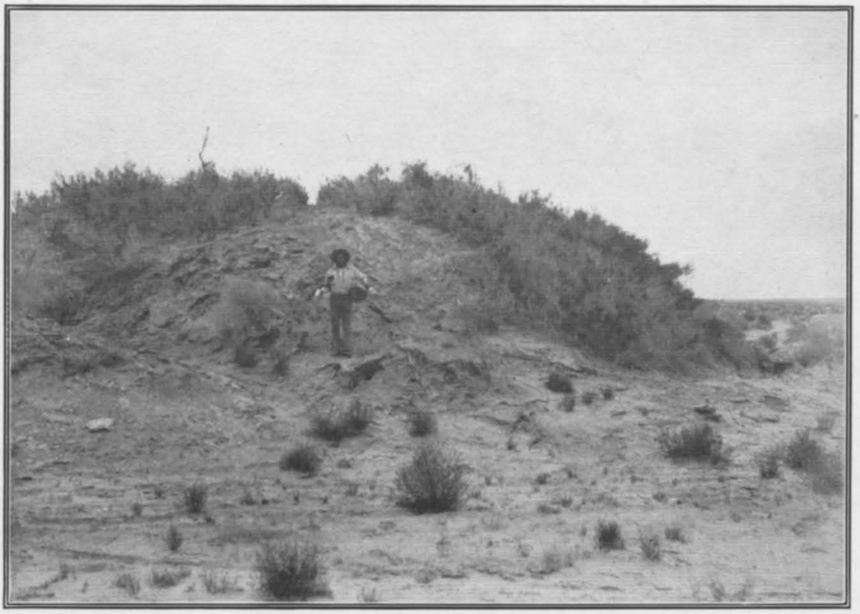


FIG. 1.—"MESQUITE MINE," NEAR IMPERIAL, CAL.

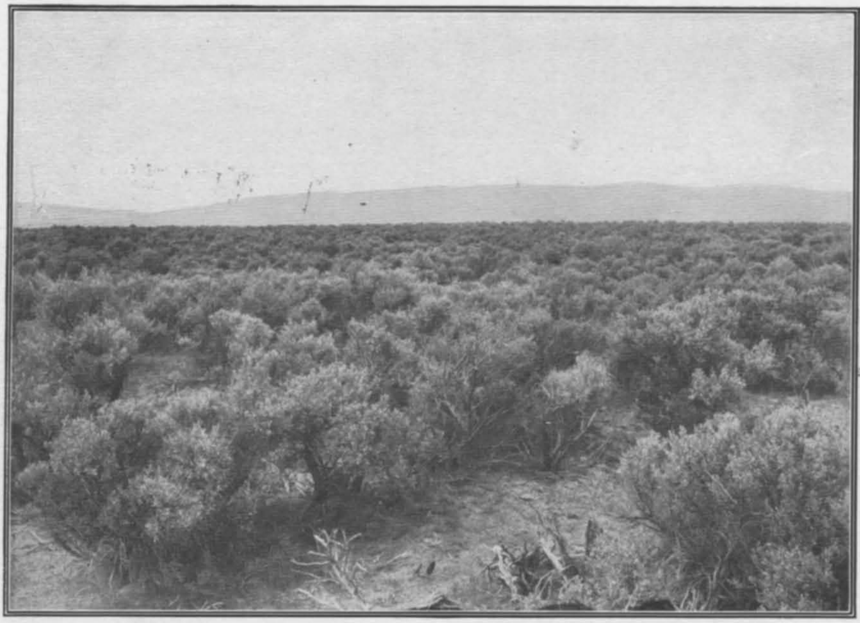


FIG. 2.—UNIMPROVED SAGEBRUSH LAND NEAR SUNNYSIDE, WASH.

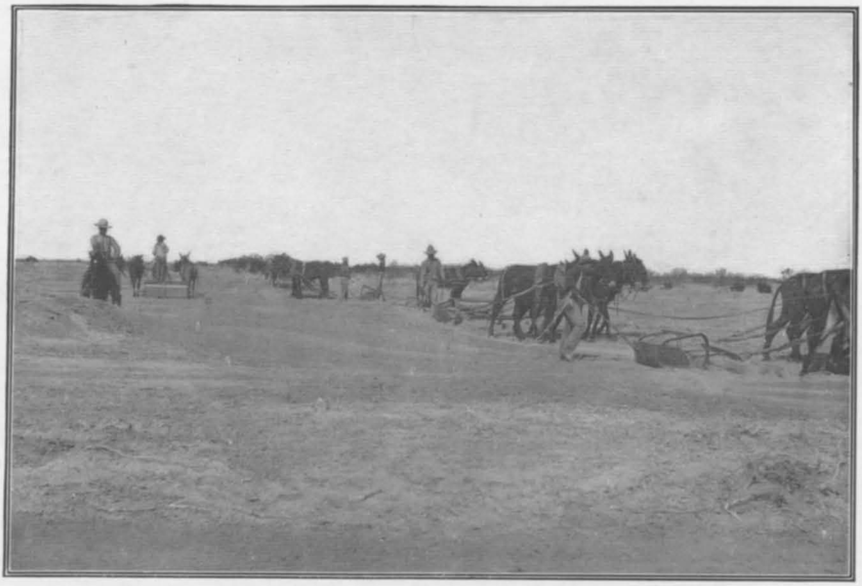


FIG. 1.—LEVELING LAND WITH SCRAPERS.

FIG. 2.—BUCK SCRAPER.

and the irrigator must spend much time in trying to make it reach the high places, while other places will become so wet that the crops will suffer.

There are, however, wide differences in practice in the amount of smoothing done. The field most easily irrigated is one which has one general slope, with no breaks; yet it is possible with more work to spread water properly over a field which is very rolling if the surface is merely smoothed. Rolling land may, therefore, be smoothed by cutting off the knolls and filling the depressions, or it may be leveled, that is, reduced, to a general slope by removing the larger inequalities in the surface; and the work and expense of preparing such land therefore varies widely with the nature of the land and the condition to which it is brought.

Fortunately, most of the soils of the arid region are light and easily worked, and as they are of the same character to a considerable depth, the surfaces of high places can be cut off without danger of removing the productive soil.

For smoothing or leveling land the common farm implements are used, as well as many others made specially for this purpose. Where the land is to be merely smoothed it is first plowed, then gone over with an ordinary toothed harrow turned wrong side up, with the timbers at right angles to the direction in which the harrow is drawn. The timbers will draw some of the soil from the high places and leave it in the low places. Sometimes a tongue is fastened to a log and it is drawn over a field in the same way with a like result. Other simple homemade implements are also used. Where the surface of the field is so uneven that more earth must be moved than can be moved by these means, ordinary road or railroad scrapers are used to move the larger quantities of soil, after which the field is smoothed with the harrow or other implement as described (Pl. XXIX, fig. 1).

One of the most common of the homemade implements for doing this work is the buck scraper, shown in Pl. XXIX, fig. 2. This scraper is usually made of 2-inch plank of any desired length, two 10-inch or 12-inch planks being securely fastened together and furnished with a steel shoe bolted to the lower edge. To these is fastened a tailboard for holding the scraper in position and for dumping it when full. The size commonly used for four horses is 8 feet long by 2 feet wide. It is securely ironed with strap iron and bolted together, as shown in the illustration. The cost of a scraper of this size is about $14. A patented improvement consists of a tailboard furnished with a lever by means of which the load may be dumped and spread with less work than is required with the plainer pattern. These are made in different lengths up to 24 feet.

Another implement used in southern California is a leveler (fig. 19), consisting of a rectangular frame with cross timbers shod with steel. It is usually made 30 feet long and 12 feet wide, of 4-inch by 12-inch timbers. The cross timbers, six in number and 6 feet apart, are spiked or bolted to the 30-foot side timbers, with the exception of No. 4, which is hung in such a way that it can be moved up or down by

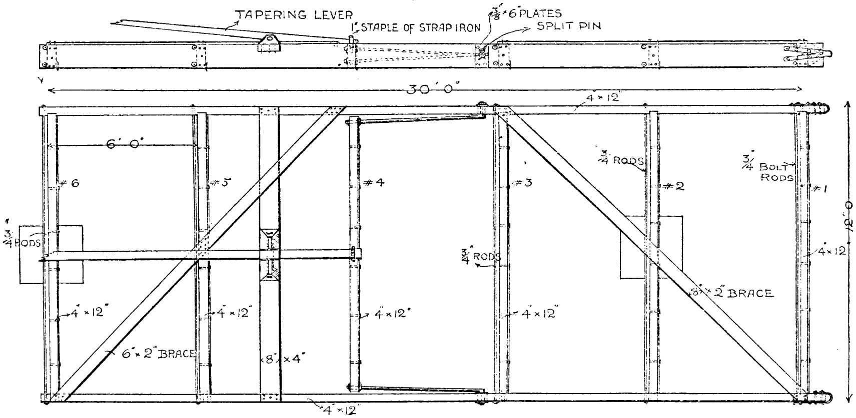


FIG. 19.—Rectangular leveler, used in southern California.

means of a lever. Each crosspiece is shod on the wearing side with a plate of three-eighths by 4-inch steel, and acts as a scraper. The leveler weighs from 1,600 to 2,000 pounds, and is drawn by 16 horses attached by chains and eveners. When the leveler is used the first crosspiece cuts off from the high points a layer of soil and spreads it out in the nearest depression, the second crosspiece takes off another

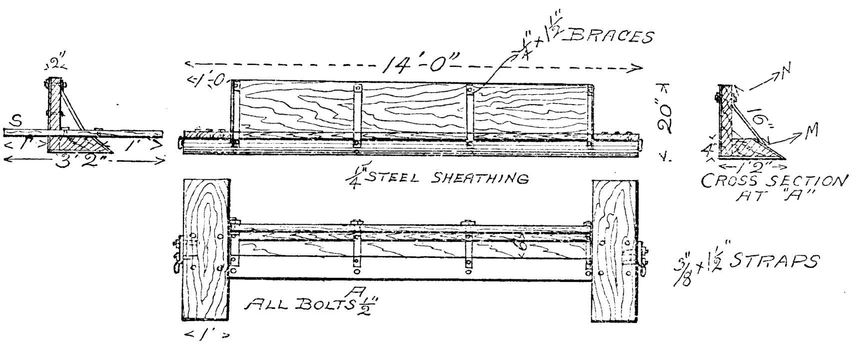


FIG. 20.—Plane leveler, used in southern California.

layer and carries the soil farther, and the third continues the process. The fourth is controlled by a lever, and can be made to cut deeper than the others if desirable, while the fifth and sixth crosspieces cut off and distribute still more of the soil from the high points. Similar levelers can be made in any dimensions, but the weight is an important element in the usefulness of the machine.

The "plane" leveler also is used considerably in southern California. Its construction is shown in fig. 20. It is especially useful on slightly uneven ground for cutting off detached hummocks and filling small washes. It consists of a base timber 4 by 12 inches, and a vertical or back section of 2-inch plank 18 inches high. The base is beveled toward the front and shod with plate steel, to make it cut into the soil. The base timber extends beyond the upright section at each end, and on these extensions of the base are placed boards on which the drivers stand and control the action of the leveler. When it is desired to cut off a layer of earth the drivers stand on the forward ends of the footboards, thus depressing the blade and making it cut into the soil. The blade is raised and the soil scattered by the drivers stepping to the rear ends of the footboards.

Besides the implements above described, there are several patented scrapers in common use. These are of the same patterns as the road scrapers common to all parts of the United States. A simple method of leveling land reported as being used in Utah is to plant the land to some cultivated crop and irrigate as well as can be done before it is leveled, letting the water applied wash the loose soil from the higher places into the hollows. When there are gullies, manure and other obstructions are placed in them to check the water and cause it to deposit the soil carried.

On rolling land which can not be reduced to a general slope the ditches for distributing water are often laid off before any leveling is done, and the land is then leveled with reference to these ditch lines. This is much less expensive than leveling a whole field together, but does not leave the fields in such convenient shape for working.

No general statement of the cost of smoothing or leveling can be made, on account of the wide differences in the original condition of different tracts and the thoroughness with which the work is to be done. Statements of the cost vary from $1 per acre to $15 per acre.

LOCATING FARM LATERALS.

For the purpose of the present paper, the farmer is assumed to have a right to water from some canal which brings it to the highest point of his farm; he has then only to build the ditches necessary to distribute the water over his land. The general plan is to run main laterals to the various fields from the point where the water is delivered, and from these laterals run smaller laterals in such a way as to reach all parts of the fields. The main laterals will interfere less with cultivation and the working of a farm if they are located along the borders of fields; and on nearly level lands they can be so located. Water will be taken from them only at certain points, and they can be made straight even if some cuts are necessary, just so they are above the

surface at the points where water is to be delivered. On rolling land they must be located on the ridges, regardless of field lines, in order that all parts of the farm may be watered from them.

The location of laterals for distributing water over fields depends upon the method to be used in applying water to the crops raised. Flooding is the most common method of applying water to grains and hay crops, while orchard and field crops planted in rows are generally irrigated by running water in furrows between the rows.

For flooding, the field laterals should run across the slope at distances of from 50 to 100 feet, so that water turned out of each one will spread over the strip of land between it and the one next below. Two systems are followed in determining what grades shall be given. One is to give considerable fall and cut the banks wherever it is desired to take water from the lateral. The other is to give very little fall; damming a lateral will then cause water to overflow its lower bank for a considerable distance above the dam.

Laterals for furrow irrigation are located in much the same way, except that they are placed farther apart. They run across the direction of the furrows in such a way that water can be turned into each furrow at its head and at such distances below as are found to be best. These distances are sometimes as great as 80 rods, but shorter distances are usually considered better. On rolling land they will not be parallel, but will be as nearly so as giving them a uniform slope will permit. One method of furrow irrigation is to have laterals or "head ditches" as nearly level as possible, and in order to accomplish this they are built up enough to make them level or nearly level for quite a distance; then the water is dropped to a lower level in a box built for the purpose of preventing the washing of the soil where the water is dropped. Pipes are then put in the lower bank, and when the lateral is dammed, water will flow evenly from all the pipes in the section above the dam. Another method is to give the laterals more slope, cut the banks where it is desired to turn out water, and then with a shovel guide the water into a number of furrows. The former method requires considerably more work in making the laterals and in making and setting the pipes, besides the expense of the pipes; but the work of applying water after the laterals have been fitted with the pipes is very much less and the distribution of water is much more even than where the latter system is used. The pipes generally used are made by nailing together four ordinary laths so as to form a tube. They cost about 6.5 cents each set in the banks of a lateral. With pipes 4 feet apart and head ditches 80 rods apart in the field this will make an expense of a little more than 50 cents an acre. Where head ditches are nearer together the expense will be proportionately increased.

Laterals must not have such great slopes that the water will cut the

banks and bottoms, but the fall must be enough to permit water to run. The greatest fall allowable will vary with the nature of the soil, clays allowing steep slopes and light sandy soils only slight falls. Five feet per mile is regarded as a minimum, while the maximum may be as much as 25 or 30 feet per mile. If it is desired to run laterals down steeper slopes than this it is necessary to run them on lighter grades and put in drop boxes. The lighter grades are hardly perceptible to the naked eye, and all laterals should be laid out by a surveyor wherever possible. However, there are simple methods which may be followed. One of the early methods employed by pioneers in irrigation was to start at the source of supply and plow a furrow following as best one could judge the proper line. After plowing for some distance, water was let into the furrow, and if it flowed to the lower end the furrow was continued; if not, the furrow was changed until water followed the plow to the end. If water flows through a furrow, it will flow with greater ease in a larger ditch located on the same line. This method is not recommended to the inexperienced irrigator. It is best when running a grade line in locating laterals to use some simple leveling instrument if a surveyor is not employed. Probably the most common type of simple, homemade leveling device is the triangle with plumb line. Another homemade leveling device is shown in fig. 21. The use of these devices has been so often explained and is so simple that it need not be described here.

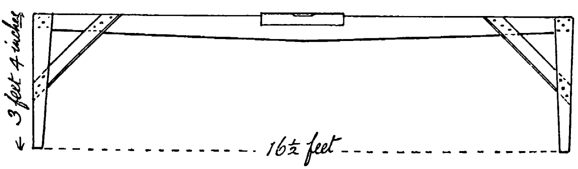


FIG. 21.—Homemade leveling device.

BUILDING LATERALS.

It is necessary that field laterals shall be built with embankments rather than cut below the surface, so that water will flow out at any points along them where the banks are cut. For this reason the line located as above described must be closely followed, when no cuts will be needed to make the water flow through the lateral.

The construction will depend somewhat on the slope of the land. If a lateral runs across a slope so steep that there is a noticeable difference in the height of the ground above and below the lateral the dirt should be thrown on the lower side. If the ground is nearly level, the dirt should be thrown on both sides.

An easy way of making a small lateral is to throw four furrows together with an ordinary plow, then with the same plow or with a single-shovel cultivator plow out the center of the ridge, making the bottom of the ditch just a little lower than the original surface of the ground. This keeps the ditch well above the surrounding land,

and the water can be taken out without trouble. After a lateral has been made in this way the banks should be strengthened with a shovel wherever the dirt has been thrown out unevenly by the plow.

Another method, described by W. F. Bartlett as being used in Colorado and Wyoming, is to plow several furrows, the number depending on the size of the lateral, and throw the dirt out with a homemade implement called an "A" (fig. 22). In building laterals by the use of an "A" a plow furrow is first made along the line of the ditch previously located, the furrow being turned to the lower side of the ditch. The "A" follows after the plow, throwing the loose dirt entirely out of the furrow upon the lower side. If the plow is then turned about and run back along the ditch line and the plowshare driven into the lower side, the "A" following the plow will throw the dirt to the opposite side. Some farmers send the "A" through the trench immediately after each furrow made by the plow; others cut several furrows as wide as they mean to make their ditch, and then throw the loose earth up on both sides of the ditch in one operation. The last method necessitates a very heavy "A," and, consequently, more horses to drag it. Should the ditch have to be made deeper than one furrow, the loose earth in the first furrows is removed and the plow is again used, followed by the "A," as before.

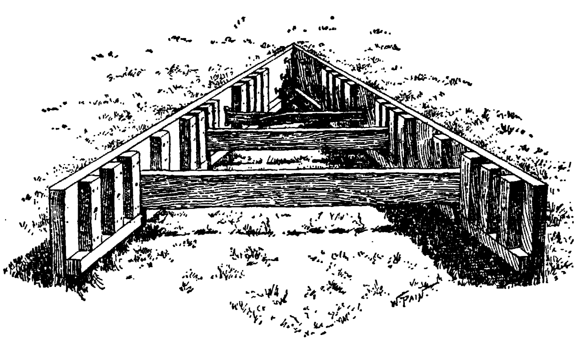


FIG. 22.—"A" for making small ditches.

Laterals are also made with ordinary double-moldboard plows or listers. Where these are not available, lateral plows have been made by bolting together two plows, one with a right and the other with a left share (fig. 23). The shares of the plows are spread to give the lateral the desired width on the bottom. The rear ends of the shares are rounded, instead of being drawn to the usual point. Above the moldboards of the plows, and riveted to them, are the right and left moldboards of old plows. The handles bolted to the lower moldboards are spread wider apart than is the case in the ordinary plow, and are braced to the beams. The beams running side by side are bent apart toward the end, making an opening wide enough to insert a 4-inch by 4-inch timber 2 feet long, which is bolted in place and on which the clevises are fastened to hang the evener. The "lateral plow" is drawn by from four to eight horses, according to the character of the ground and depth of laterals to be made. In one operation it turns two furrows to opposite sides of the ditch and throws them

high on the banks, leaving an unusually clean bottom at the desired width. Many plows of different sizes similar to this, made entirely on the farm or with the help of the village blacksmith, may be seen throughout old-established colonies like Greeley, Colo., and vicinity.

After laterals have been made with the double-moldboard plow as described, they may be cleaned out with what is known in Montana as a "dammer." This consists of a 14-inch or 16-inch steel shovel attached to a beam, and having handles like those of a walking plow. In use the implement is drawn by one horse, walking in the ditch made with the plow. The loose earth on the bottom and sides of the ditch is carried forward by the shovel and dumped in heaps in the ditch at whatever distances it is desired to have dams. The earth is dumped by raising the handle of the dammer. If enough earth for making the dams is not scraped together in one trip, the dammer is drawn through the ditch a second time in the opposite direction, adding the earth collected to the piles made in the first trip.

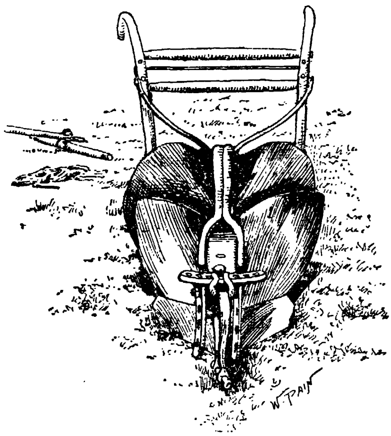


FIG. 23.—Lateral plow made of right and left plows.

When a farm has been properly leveled and the ditches have been built, there will be ditches carrying water to each field; a supply ditch will run along one side of each field, if the slope is such as to allow of its being located there, and from this will run the ditches through the fields at the intervals which are considered best for each particular field in whatever direction gives the proper slope. All but those through the fields are considered permanent ditches, and those may be so, or may be filled in before the cutting of grain or hay, so as not to interfere with the use of machinery.

Water is brought to the supply ditch of a field and is turned from it into the first ditch running from it through the field. It flows down this until it comes to a dam made as described above. This dam holds the water, which will either overflow the lower bank of the lateral or flow out through the pipes set as described or through cuts made in the banks. When enough water has flowed from the section of the ditch above the dam to cover the land between that section of the ditch and the ditch next below, the dam is broken, and the water flows down to the next dam, and so on across the field. When the strip immediately below the first ditch is irrigated the water is shut out from that ditch and turned into the one next below. If the stream supplied is larger than is necessary for one of these field ditches, it is allowed to flow into two at once, and the time required to water a field is reduced accordingly.

THE CHECK SYSTEM.

The check system of irrigation does away very largely with the construction of field laterals and reduces greatly the work of applying water. The preparation of land for irrigation in this way is essentially different from the preparation for the systems of distribution described above. In this system fields are divided into basins by embankments; these basins are filled or partially filled with water, and no supervision is necessary to see that the water flows all over a field. The embankments hold the water, and enough is applied to cover the whole area inclosed by them. It will be seen at once that this system can be used only on lands which have a very uniform and slight slope; otherwise it would require very high embankments on the lower sides of the basins to hold the water high enough to cover the upper sides, or else the basins would have to be very small. This system is used exclusively for rice in Louisiana and Texas, and to some extent for grain and hay crops in other sections. It is also used for orchards in some localities. For the use of this system it is necessary to build embankments along the borders of fields, and then run embankments on level lines across each field in such a way as to divide it into a series of basins. A field which has a general slope in one direction of 1 foot in 100 feet would have embankments across this slope at distances of about 100 feet, and each would need to be a little more than 1 foot high to hold water high enough to cover all the land between it and the one next above, the base of one being just 1 foot higher than the base of the other. Land to be irrigated in this way requires the same or more leveling than for the other systems, except that the level of each basin can be independent of the others; and it requires in addition the construction of the embankments or levees, but not the construction of any field laterals, except such as are necessary to bring the water to all the basins, and in some places each basin is filled from the one above.

Two forms of embankments are used. One is made only so wide as is necessary to hold the water, and is therefore too steep to be crossed by machinery. The other is made broad, with such gradual slopes that it can be crossed with harvesting machinery without trouble. The narrow embankments not only hinder the operation of machinery, but they withdraw considerable land from cultivation, and are likely to be covered with weeds whose seeds are easily scattered over the fields. The broad ones, on the other hand, can be cultivated, and therefore withdraw no land from crop production and produce no weeds. These broad embankments are constantly growing in favor. They must be level, and therefore must be located with even greater care than laterals. The same homemade leveling devices described for laterals will serve, however, for locating the lines for embankments.

The narrow embankments are made by throwing together two or more furrows and by scraping together more earth with ordinary scrapers, being careful, however, to take only a thin skimming of soil, so as not to make low places in the fields. The larger embankments are made in much the same way, except that they require the moving of more earth. The buck scraper described on page 241 and the various patent road graders are useful for making such embankments. As was stated, the work of applying water by this system is much less than that required for the other system. It is only necessary to turn the water into a basin and let it flow there until the basin is full; then shut it off and turn it into the next basin.

THE USE OF METAL PIPES AND CANVAS HOSE.

A system of applying water which does away with the necessity of leveling land to some extent and entirely with constructing field laterals has recently been adopted in parts of California. Water is distributed over fields through metal pipes and canvas hose. However, as this requires that the water be under some pressure, it can not be used where the water is taken to fields in open ditches. In many parts of California water is distributed to the fields in underground pipes under more or less pressure and delivered from cement standpipes. Where this is the case the pipes and hose can be used, being attached to the standpipes. The pipes are of galvanized iron, heavy enough to stand ordinary handling, in sections from 12 to 15 feet in length, and are made to fit together like stovepipe. The hose is made of long strips of canvas, with the edges sewed together, and is sometimes soaked in tar or oils to make it hold water better. Either pipes or hose can be used alone or the two may be used together. The pipe is coupled up so as to reach nearly to the lower side of the field to be irrigated and the water is turned on. When the part of the field beyond the end of the pipe has been watered a section of the pipe is removed and another strip is watered, and so on until a strip clear across the field has been served. The pipes are then connected with the next standpipe and another strip is watered in the same way. Slight unevenness in the surface will not interfere with the use of the pipes, and water can be carried up slight grades. When this system is used there are no ditches or embankments to interfere with cultivation and the use of machinery. The chief disadvantage is the expense for pipes and hose. Mr. A. P. Stover reports that one 40-acre tract in California is irrigated by the use of 500 feet of galvanized iron pipe and 800 feet of canvas hose. The pipe cost $90 for the 500 feet and the hose cost $68 for the 800 feet, making a total cost of $158, or $3.95 per acre for the 40 acres—considerably more than the expense for the construction of laterals. In addition to the advantages pointed out the use of pipes and hose prevents the loss of water which takes place when water is carried in open ditches.

SUMMARY.

From what has been said, it is clear that no exact statement of the cost of preparing land for irrigation can be made. Estimates from various sources show the following range of cost for the operations of preparing land for irrigation by furrows or by flooding, which are not necessary in preparing ordinary prairie land for cultivation without irrigation:

Cost per acre of preparing land for irrigation.

Removing sagebrush	$1.50 to $3.00
Leveling land	1.00 to 15.00
Removing stones	30.00
Laying out and constructing laterals	1.00 to 5.00
Total	3.50 to 53.00

In preparing land for irrigation in checks the building of embankments does away with the construction of field laterals, but the expense for the embankments is probably greater than that for the laterals. The cost of metal pipes and canvas hose used instead of field laterals is stated as $3.95 per acre. This, however, must be paid out in money, while a farmer can usually level his own land and build his own laterals, making a smaller cash outlay.

The above estimates show that the expense for preparing a homestead of 160 acres for irrigation runs from $560 to more than $8,000. To this must be added the cost of the water supply, which runs from $10 up to $100 or more per acre, or $1,600 to $16,000 for the 160 acres. The whole expense for beginning farming by irrigation runs from $13.50 to $150 or more per acre, or from approximately $2,000 to $25,000 for a homestead of 160 acres. The lower figure may be regarded as the minimum cost. The greater expenditures are largely optional. More thorough preparation of land means a greater expense, but less work in applying water, the use of smaller quantities of water, and the raising of better crops. It is better if this additional work can be done before irrigation is begun, but if a farmer can not meet the added expense he may make the improvements from time to time as he is able.

THE ADULTERATION OF DRUGS.

By Lyman F. Kebler,
Chief of Drug Laboratory, Bureau of Chemistry.

Introduction.

The prosperity of a nation depends to a large extent upon the health of its people, and one of the factors that contribute largely to this end is the purity of medicinal remedies. Without reliable anesthetics the surgeon would virtually be helpless, and without pure medicines which he can fully rely on the general practitioner would have little hope of successfully guiding his patients through serious attacks of illness. That medicines frequently vary and are sometimes below the standard will not be gainsaid by many, but the large majority of druggists make an honest effort to supply the public with the best possible goods that can be purchased or manufactured. In some cases these variations are due to the absence of standards, in others either to greed on the part of the proprietor or to carelessness or incompetence on the part of employees, who are sometimes woefully ignorant of the preparation of medicine.

EARLY MENTION OF ADULTERATED DRUGS.

It has been known for many centuries that the quality of medicinal agents, especially those derived from plants and animals, is liable to great variation, and the first general works on adulteration were devoted chiefly to drugs. The various herbals make mention of the falsification and substitution of crude herbs. As early as 1481, Saladin of Ascala, an Italian physician, wrote a treatise on the aromatic principles of drugs, entitled "Compendium Aromatarium," in which he described the case of an apothecary who was heavily fined and deprived of his civil rights for adulterating manna with sugar and starch.

King James I, of England, empowered the Apothecaries' Society, through its charter, to enter into the shop of any chemist (as druggists are called in England), in London, and determine whether his medicines were meet and fit for the cure of His Majesty's subjects. The society was further authorized to burn before the door of the offender such medicines as were found to be corrupt, pernicious, or hurtful. In

commenting on this charter, Mr. Glyn-Jones, an eminent English apothecary, says:

> I can only say that if this was still law and those who administered the sale of food and drugs act were the people empowered to do the inspecting, what with their idiosyncracies, the lack of authorized standards, the multiplicity of unauthorized standards more or less all varying, the result of a combined visit would be that the present day representatives of the old apothecaries would be burned out of shop and warehouse about once every year.

In 1660, Francesco Redi, of Florence, published the results of some of his experimental work relative to the amount of mineral matter contained in black pepper, ginger, and black hellebore. In each case 100 pounds were burned, and it is well known that the data obtained by him are in close accord with present standards for these articles. J. B. Vanden Sande, an apothecary of Brussels, in 1784 published an octavo of 430 pages on the adulteration of drugs. In this volume are recorded methods for disclosing some of the tricks resorted to in those early days for falsifying medicinal remedies. He not only described the external characteristics of the drugs used at that time, but also made alcoholic and ethereal extracts and determined the amount of extractive matter in many—a great step forward.

TWO METHODS OF ANALYSIS.

Record is thus made by two authorities of the pioneer work of two analytical methods that are at present advocated as of great service in judging the quality of crude drugs and certain liquid preparations made from them. The one method deals with the amount of ash present, and the other is based upon the amount of material a given solvent will dissolve under specified conditions, and is called the extractive method. The ash method is of service, in that it gives some idea of the amount of care exercised in collecting the drug, but it affords little information as to its actual efficiency, unless gross fraud has been practiced such as allowing an undue amount of earth to adhere to the roots or deliberately adding inorganic matter for gainful purposes.

The amount of extractive material contained in some drugs is of the greatest importance. It is very useful in keeping a check upon the completeness or incompleteness with which a given drug has been exhausted in making medicines and also in keeping the physical appearance of the preparations fairly uniform, but it is a well-known fact that the amount of material a certain solvent removes from a given drug usually bears little relation to the activity of the medicine. There are, however, some exceptions to this. For example, certain resinous drugs of good quality, like benzoin, usually contain a definite amount of material soluble in alcohol. Standards for medicines made from articles of this character could readily be set.

FACTORS AFFECTING QUALITY OF DRUGS.

The quality of crude drugs is dependent on many factors, such as climate, altitude, soil, time of collection, manner of curing, storage, transportation, and age. For example, oil of lavender distilled from plants grown in England is considered much superior to that made from plants grown in France, and an oil derived from plants grown at a high altitude is materially different from that produced from plants grown at or near sea level. Every farmer knows that grass grown on dry soil, under favorable conditions, is much superior to the rank grass grown on low, wet soil, with a superabundance of moisture.

TIME OF GATHERING MEDICINAL ROOTS.

Medicinal roots gathered late in the autumn or in the early spring are quite likely to contain much more starch and a correspondingly smaller amount of the active medicinal agents than those gathered late in the spring or in the early summer. For example, mandrake root collected at a certain time in the spring, and known as "spring root," contains a larger percentage of podophyllin than does the root commonly known as "fall root." The physical appearance of the latter root is much superior to that of the former, though the appearance of crude drugs is frequently no criterion as to their value. It is just as important to know the exact time for collecting medicinal plants, so as to get the best possible products, as it is to know the proper time to sow and harvest crops. Such a knowledge is exceedingly important regarding drugs, because the virtue of these plants frequently depends solely on the existence of certain active principles that are present in greatest abundance at certain stages of development.

METHODS OF CURING.

Again, proper curing is a most important factor because carelessness in this respect is apt to destroy the efficient active principles, and in some cases the quality and value of the prepared article depend largely on the development of certain useful bodies during the process of fermentation.

The elaborate methods at present practiced in preparing for the market such products as vanilla beans, tea, tobacco, etc., are the result of many years of experience, and give an idea as to the care that must be exercised in preparing the best possible crude drugs. It may be true that our present analytical methods are not sufficiently refined to differentiate between certain inferior and superior drugs, but the skilled therapeutist is as able to appreciate the differences that exist as is the tea expert to select one grade of tea from another or the vanilla expert to tell the difference between Mexican and Bourbon beans.

CARE IN STORING.

After a crop has been properly gathered and cured it is very essential to store it with the greatest possible care. Excessive moisture is likely to induce fermentation, and too much heat is conducive to the loss of some of the active volatile principles. The same points must be observed in transportation, for it often happens that goods are seriously damaged during ocean voyages. Many drugs deteriorate with age, and some become absolutely worthless for medicinal use.

IMPORTANCE OF PURITY OF DRUGS.

The purity of drugs and the accurate dispensing of the same are of such vital importance to everyone that it is surprising that so little attention has been given to the subject by those in charge of such matters. It is not because there is any particular apathy on the part of our legislators, for many of the States have laws authorizing the investigation of medicines, and in a few States their quality has been and is being studied. The various reports, however, which come to us from time to time treat of the adulteration of drugs in a very superficial manner. The reason for this, it is said by some, lies in the difficulties encountered in making accurate analyses of many of the pharmacopœial preparations, especially those of animal and vegetable origin. It is undoubtedly true that the United States Pharmacopœia, an authoritative book used by druggists in the preparation and testing of many medicines, is a sealed and often unheard-of volume to many analysts, chiefly because they have not been trained as pharmaceutical chemists. Organic medicinal remedies present numerous analytical difficulties, but no more than do many phases of food analysis, and there is no good reason why drugs should not receive the same systematic study as do food stuffs. Another reason given for the apparent lack of investigations of health-restoring remedies is that the question of foods is more important and should receive the first consideration. In this connection, it should be remembered that if the foods we eat are diluted by some inert, harmless substance, so that a given quantity does not satisfy the demands of the body, the system craves more and we can supply the deficiency, while our suffering sick have no way of telling whether the medicines they are taking are good, bad, or worthless; nothing in the human system indicates whether more or less is needed, and the sick can only take what is given them and continue to suffer.

EXTENT OF ADULTERATION.

A careful perusal of the meager reports on the examination of drugs issued in conjunction with food and health reports leads to the belief that from 50 to 75 per cent of the medicines dispensed by the druggists are either willfully adulterated or of inferior quality. If

such a condition really exists it augurs ill for the future welfare of the pharmacists of this country; but some of these reports plainly state that the drugs examined have been for the most part such as experience shows are most liable to adulteration. While this in a measure palliates the druggists' offense, nevertheless the stubborn fact remains that many of the standard medicines sold by them are below the requirements. A recent editorial[a] on the adulteration of drugs in New York City, at present being exposed by the city board of pharmacy, contained the following statements:

> The sale of adulterated and inferior drugs is shamefully prevalent, but we still refuse to believe that the conditions are a particle worse than they always have been. The preparations examined are those usually made on the premises, tinctures of iodine, etc. A large proportion of the samples were far below official strength and some were adulterated with cheap and inferior material. In most cases the samples were below standard strength because they had been prepared by incompetent or ignorant persons. The result is the same as far as the effects are concerned. The ignorant shopkeeper who has for years been a reproach to the drug trade must go. The present campaign places a premium upon the thoroughly able and honest pharmacist.

CARE ON THE PART OF PHYSICIANS AND PHARMACISTS.

Years ago a disinclination on the part of the physician, the druggist, and the chemist to investigate the agents used in the art of healing was excusable to a certain degree because our knowledge of the active constituents of drugs and the methods of isolating them was deficient; but many of these difficulties have been to a large extent removed by systematic and painstaking investigations. The graduates of our colleges are not only taught how to estimate many of these active principles, but they are also conversant with the analytical methods employed in determining the quality of the goods to be handled. For example, the graduate in pharmacy is familiar with the methods used in determining the quality of spirit of nitrous ether, and well knows that this preparation is a perishable article, as is milk, and consequently there appears to be little excuse for selling a deteriorated product.

Some physicians have cultivated the practice of carefully studying the quality of the medicines supplied their patients, for they realize that uncertainty in the quality of these remedies is a dangerous element when dealing with the desperately ill. One physician writing on this subject says: "If a census could be made of those who die annually from the use of drugs which are impure or useless from weakness, the writer believes that a most alarming array of figures would be presented." The close relation of drugs to life and health is so well known to physicians that many of them urge that every possible means be adopted to prevent material variations in the quality and potency of the remedies they are constantly using.

[a] Pharmaceutical Era, 1903, *33*: 595.

With proper knowledge on the part of the pharmacist and due care exercised by the physician, it ought not to be difficult for the public to purchase medicines which will comply with the standards set by the Pharmacopœia. In certain cases the requirements have been made very stringent, possibly unduly so; at least some manufacturers declare that they are unable to supply certain products of the quality desired except at exorbitant prices. However this may be, it is a matter of common experience that many of the chemicals at present supplied for medicinal use deviate materially from the recognized standards. Conditions of this character place the druggist in a very embarrassing position. He is punishable by the laws of certain States for selling goods below the standard. The public sometimes questions his integrity. He can not materially raise his prices without provoking severe criticism and suffering loss of patronage. The revisers of the forthcoming edition of the Pharmacopœia have no doubt investigated the manufacturers' contentions and adjusted such as were well founded

THE UNITED STATES PHARMACOPŒIA.

The seventh decennial edition of the United States Pharmacopœia contains standards for a number of powerful drugs, together with the methods for determining and adjusting the same, and it is hoped that this commendable policy will be extended to other potent medicinal remedies as rapidly as practicable. Standards, however, are of little service unless accompanied by suitable laws which are conscientiously and judiciously enforced. For example, an examination of a dozen samples of laudanum, for which the Pharmacopœia sets a standard, collected at random, showed a variation of 500 per cent. This could not be due to material variations in the crude product, for all opium imported into this country is examined by the custom-house officers, and if it contains less than 9 per cent of morphine on the moist basis it is virtually excluded by a duty of $6 a pound. Tincture of nux vomica is reported as varying from double strength to only traces of the active constituents. The latter condition may be due to great variations in the crude drug, for which there is no recognized standard at present. It is evident, however, that the druggists who make such preparations do not adjust them to the proper standard.

Until recently the United States Pharmacopœia was regarded as semiofficial in character within this country. Its standards and methods for making medicinal agents were only nominal, yet they were widely respected. This book was originally intended as a guide for the druggist in the preparation and testing of the medicines he handles, but there was no law by which he could be punished if they did not comply with the pharmacopœial standards. Within recent years a number of the State laws have prescribed the Pharmacopœia as the legal

standard. This will tend to bring about a greater degree of uniformity. Those whose duty it is to investigate the quality of drugs have already shown considerable aggressiveness, and it behooves the manufacturer and the dispenser to adhere closely to the directions of the Pharmacopœia in their work. The Revised Statutes of the United States recognize the Pharmacopœia as standard for imported drugs and medicines, as is shown by the following sections:

SEC. 2933. All drugs, medicines, medicinal preparations, including medicinal essential oils and chemical preparations, used wholly or in part as medicine, imported from abroad, shall, before passing the custom-house, be examined and appraised, as well in reference to their quality, purity, and fitness for medical purposes, as to their value and identity specified in the invoice.

SEC. 2935. If, on examination, any drugs, medicines, medicinal preparations, whether chemical or otherwise, including medicinal essential oils, are found, in the opinion of the examiner, to be so far adulterated, or in any manner deteriorated, as to render them inferior in strength and purity to the standard established by the United States, Edinburgh, London, French, and German pharmacopœias and dispensatories, and thereby improper, unsafe, or dangerous to be used for medicinal purposes, a return to that effect shall be made upon the invoice, and the articles so noted shall not pass the custom-house.

SKILL SHOWN IN ADULTERATION.

Gross adulteration, such as crystallized plaster of Paris sold for tasteless quinine, saffron loaded with heavy spar, leaves mixed with stems and admixtures of foreign roots, are not very frequently practiced. But starch is yet mixed with beeswax and Japan wax; pieces of iron, stone, and lead are often found in lumps of opium; cobblestones are placed within bundles of sarsaparilla roots, and earthy matter mixed with asafetida. Adulterations at the present time, however, are for the most part conducted on scientific principles or else consist in selling goods merely of inferior quality. The modern adulterator is usually well versed in the most recent discoveries of science bearing on his particular products, and if his manipulations are disclosed along certain lines he immediately turns his energies in another direction; consequently he is usually one step in advance of the analyst. He is constantly watching standards. If certain specifications state that oil of sandalwood must contain not less than 95 per cent of its peculiar alcohol, and his stock oil does not contain the proper amount, he will simply add a sufficient amount of glycerin to bring the alcohol content up to the standard.

The selling of goods below the standard is extremely prevalent. This is in a measure due to the use of inferior drugs in preparing the medicines, but more often it is caused by the use of an insufficient amount of the crude material or by deterioration due to old age. It is essential in fixing standards for certain perishable articles to study them well, and carefully avoid placing the standard too high. This is of supreme importance, as the character and the livelihood of the vender are involved.

PROPOSED STUDY OF DRUGS AND THEIR PREPARATION.

At the last meeting of the Association of Official Agricultural Chemists a referee on medicinal plants and drugs was appointed. The object of this appointment was to provide for the study of the methods used in determining the quality of drugs and their preparation, along the same lines that have proved so successful in providing standard methods for the analysis of other substances, such as foods, etc. All pharmaceutical chemists will be invited to cooperate in this work, which will necessitate years of careful, patient, and painstaking study and experiment. There is every reason to believe, however, that in this way the best methods of analysis for the various drugs and their preparation will ultimately be established. Well-tested and uniform methods of analysis mean concordant results in the hands of chemists, and men of affairs will place confidence in such analytical results.

BUILDING SAND-CLAY ROADS IN SOUTHERN STATES.

By W. L. Spoon,
Special Agent, Office of Public Road Inquiries.

INTRODUCTION.

It is a matter of common observation that here and there in the Southern States are to be found stretches of sand-clay roads never known to be bad. This fact has led to a study of the reasons why such roads are always good. Numerous experiments have been made with varying results, but all indicate that the essentials to success in sand-clay road building are puddling and saturation. What is meant by puddling, or mixing, may be clearly understood by anyone familiar with the operations in the process of brickmaking. The clay must be rendered homogeneous, and this can be done only by the addition of water during the process until the clay becomes plastic like dough. The second essential is the addition of sand to the point of saturation, but not beyond. What is meant by saturation may be clearly understood by reference to fig. 24, which shows a magnified cross section of sand-clay composition as found in a substantial sand-clay road.

Let it be clearly understood at the outset that no sand-clay road can satisfactorily withstand the severity of public travel without having first been reduced to a compact homogeneous mass of sand and clay. Each grain of sand should be in touch with other grains on all sides (fig. 24). Such a condition can not be secured without the agency of water. It is useless to roll a dry sand-clay road before it has been rendered homogeneous by the puddling process and the grains of sand have been brought into contact, with only the interstices between them filled with clay as a binder. The first operation is mixing; the second is rolling as the mixture dries. This forces the particles of sand together, and any excess of clay tends to rise to the surface, rendering it sticky. This clay must in turn be sanded and the operations repeated until the surface has become hard and compact.

CAUSES OF FAILURES IN BUILDING SAND-CLAY ROADS.

Many failures have been made in the building of sand-clay roads, and a few of the more common causes for these failures will be pointed out.

IMPERFECT DRAINAGE.

The first cause of failure is the want of perfect drainage. The imperfections may be in the cross-sectional drainage, the side ditches, or the drainage of the subgrade or roadbed. It is customary to give to a sand-clay road a little greater crown than is usually given to a macadam road, especially where the grade is above 3 per cent. The subject of side ditches should have more careful consideration than is usually given in case of macadam roads. If the subsoil upon which the road is built is clay, it is important that the bottom of the side ditches should be 18 inches or more below the crown or middle of the traveled track. If, on the other hand, the land is rolling and the subsoil is sand of considerable depth, thus giving perfect natural drainage to the roadbed, little or no side ditch will be required. Perhaps the most common error in drainage is the failure to drain properly and thoroughly all places where there are wet-weather springs. If necessary, the roadbed must be changed so as to locate it upon dry ground, as even the deepest side ditches practicable may fail to give relief where such springs exist. It is important to avoid deep cuts and to carefully consider all probable sources of trouble. The writer has often seen old roadbeds with water oozing from all parts during a rainy season, in spite of sufficient side ditches, the water even rising in the center of a 20-foot roadbed and standing on the surface, or slowly running along the wheel tracks to the nearest mudhole. It should be remembered that water, beyond a very limited amount, adds nothing of value to the sand-clay road after it is completed. If water is always present, sand should be used without clay. Sand and water make a better road than sand and clay and water. In proof of this statement, attention need only be called to the numerous places where water crosses the roads in sandy districts. Such fords are always comparatively

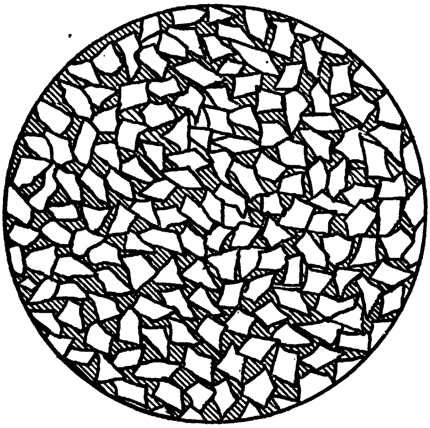


FIG. 24.—Clay mixed with sand to the point of saturation, the angular sand grains being in contact.

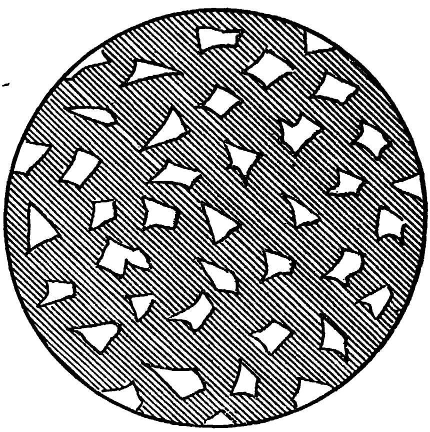


FIG. 25.—Sand-clay mixture with not enough sand, the grains not being in contact.

solid. On the other hand, where there is an excess of clay at such places there is apt to be deep mud.

It is easy to see why a road with the structure shown in fig. 24 will stand, wet or dry, while one with the structure shown in fig. 25 will fail, particularly in wet weather, because the clay when it becomes wet is plastic and the particles of sand, not being in contact with each other, are easily displaced, and in consequence of such displacement loaded wheels sink into the roadbed and destroy it. The remedy is clearly to add sand until the point of saturation is reached and the grains of sand come in contact with one another, assuming fixed positions.

INFERIOR MIXING.

Another cause of failure is the want of thorough mixing. There may be a proper amount of sand, and clay may be placed upon the road, yet if it is not thoroughly puddled and mixed to saturation in every place the road is not likely to withstand public travel. Some sections will break and become loose sand, while others will become muddy in wet weather and hard in dry weather. Such variations may occur every few feet and even at the same place, one wheel track being in loose sand and the other in mud. On one occasion the writer saw a street being torn up for macadamizing, because, as they said, the sand-clay mixture had failed to give satisfaction. The street was from side to side alternating holes and ridges, and practically worthless. When the material was torn up it could be observed that at least 50 per cent of the clay was in lumps from the size of an egg to that of a man's head, just as digged from the clay bank and dumped upon the street. The trouble resulted from too little sand and no attention to the mixing when the clay was wet and plastic. When ridges and holes began to form, more sand should have been added and all high places should have been leveled down to conform to the general contour of the street's crown. By this means uniformity of mixture would have resulted, and, when a sufficiency of sand had been added to saturate the clay for a depth of 10 inches and a good crown had been given to the street, all the traffic customary on such a thoroughfare would have been easily accommodated without mud or inconvenience.

FROST AS A DESTRUCTIVE AGENT.

In northern sections frost is another cause of failure and one more difficult to deal with than any heretofore mentioned. Frost is temporarily destructive to a sand-clay road, and for that reason the mixture must extend below the frost line if the road is built on a clay foundation. Freezing disintegrates the sand-clay composition and makes of it a soft, slushy mud, which, however, repacks again after each heavy rain, although frequently leaving the road surface somewhat rough.

Therefore, in general practice it is necessary to make the sand-clay mixture of such a depth as to extend a few inches below the frost line. It has been suggested that crude petroleum would be admirable in its effects upon this class of roads in higher latitudes; but so far as the greater part of the South is concerned the frost line is rarely more than 1 to 3 inches below the surface, and freezing to this depth does not seriously disturb the body of a sand-clay road, and as these frosts are only occasional they do not sufficiently disturb the road to make necessary the use of oil to prevent the absorption of moisture. Snow and sleet are also of rare occurrence and of short duration in the South, the surface of the road being soon exposed to the drying effect of the sun's rays, when it again becomes hard and resistant.

INFERIOR MATERIALS.

Failure is sometimes due to the kind of sand selected. None except sand made up of angular grains is adapted to sand-clay road making. Sand with grains which are worn off round, or sand which has been ground up by the action of wheels or water until very fine, is unsatisfactory and often worthless. The use of such material should be avoided, as a perfect bond can not be effected (see fig. 26), and the road can not resist the rolling action of wheels, the tendency being much the same as when pressure is applied to a mass of marbles. Care should always be taken to select the sharpest and cleanest sand that can be found.

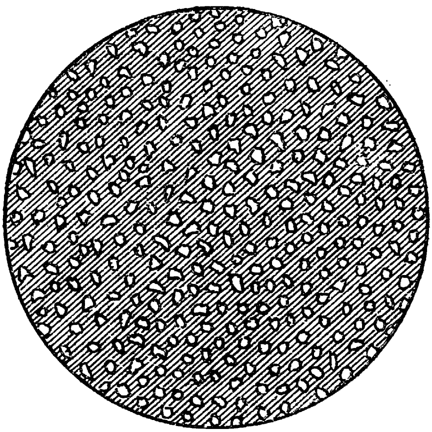


FIG. 26.—Unsatisfactory sand-clay mixture, the sand grains being worn round.

Other causes of failure are the improper selection of clay and the improper treatment of the clay used. Ferruginous clays are the best, and chalky clays, as they are commonly known, are the poorest for road-building purposes. Some clays have a large percentage of sand to begin with and require less sand, while as a rule the chalky (sedimentary) clays have very little sand, or very fine sand, and are more difficult to get fully saturated with sharp sand so as to become unyielding and homogeneous.

Another cause of failure in the use of this particular clay is the fact that it rarely has iron enough to cement or bind the material together; hence it is easily broken up and washed away or blown away as dust.

LACK OF PERSEVERANCE BY THE ROAD BUILDER.

Another cause of failure is lack of perseverance on the part of the road builder. Probably more failures result from this than from any other cause. It must be borne in mind that building a sand-clay road is a process and not an instantaneous operation. The builder may fail when well within view of success. He must be guided by the manifestations. If clay is in excess, there will be a tendency to form mud in wet weather; if sand is in excess, the tendency will be to break up into deep sand during the dry seasons. There is a sufficient middle ground between these two extremes to permit of wonderfully improving the deep sand roads of the South and greatly bettering the clay roads of the Piedmont section.

HOW TO USE AVAILABLE MATERIAL.

As the road builder is forced to use such sand and clay as is available, he should learn to build the best possible road with the material to be had; hence the chief object of this paper is to show how the material may be used to the best advantage. There are many localities in the Southern States where sand very largely predominates, and the only clays to be found are sedimentary, often carrying a large percentage of very fine sand and scarcely any iron at all. It is usually difficult to build a really first-class road of this material. The first step should be to make the roadbed at least 20 inches above standing water in the ditches. This must be carefully attended to if the country is level and the drainage poor. No road of any kind is likely to prove satisfactory unless drainage of the roadbed is carefully provided for, and especially is this true of a sand-clay road made of sedimentary clay and fine sand. Possibly more depends upon the sand selected than upon the clay. The coarser the sand, the better the road will stand. Wherever the road shows a tendency to break in dry weather, more clay should be added.

EXAMPLES OF GOOD SAND-CLAY ROADS.

It may not be amiss to point out by way of encouragement a few of the many places where most excellent roads have been built of sand and clay, which are to-day the equal of macadam roads costing many times as much.

Pl. XXX, fig. 1, gives a view of a road in Richland County, S. C., about 3½ miles from Columbia. This road is known as the Garners Ferry Road, and has been in use under the heaviest travel for five years without any repairs. It was originally very deep sand. It was built about 32 feet in width between ditches and sustains an enormous daily travel, much of which is very heavy, and narrow-tired wagons are commonly used. Nevertheless, the surface is, as shown in the illustration, free from ruts, hard, and smooth.

Pl. XXX, fig. 2, is a view of a sand-clay road built under the supervision of the Office of Public Road Inquiries just outside the corporate limits of Newbern, N. C., about fifteen months ago. This roadbed, which is less than 15 feet above mean tide-water level, was of the deepest and finest sand, and the clay used was sedimentary and of very ordinary cementing properties. The road was laid out 30 feet wide and crowned to a height of 12 inches above the ground surface, the ditches being cut about 12 inches deep at the outside edge and 3 feet wide. These ditches were sloped from the roadside toward the outside. The ditches do not show in the illustration, because they have been allowed to become overgrown with grass and weeds, not having been cleaned off since the road was built. This road is used by some of the largest truckers around Newbern, and many thousands of cartloads of truck are hauled over it each season. This Newbern road was reported upon as follows last June by Mr. William Dunn, who used it very largely last winter and spring:

I am in receipt of your letter of recent date asking about the sand-clay road. It has worn remarkably well through the winter, requiring but little work; in fact, the first half of the road has needed only to be scraped. The portion of the road last finished was quite bad at first and remained so for a long time. It was sanded and resanded and scraped, and it finally settled and became hard, and is now, and has been for some time, in good condition. The part nearest town has never given any trouble. I think the material used was of just the proper consistency, there being sand enough in it to prevent cutting.

The part of this road nearest the town, where the road was begun and which Mr. Dunn says has never given any trouble, is shown in Pl. XXX, fig. 2. It should be remarked that there is scarcely any place where conditions could be more unfavorable, and still this road has more than doubled the hauling capacity of the truckers living along the line. This means to them a vast saving, because truck has to be so rapidly handled when in season that many teams have to be hired from the town. In consequence of this improvement fewer teams are needed in the delivery of truck to the railroad.

At Tarboro, N. C., another section of sand-clay road work was done under the direction of the Office of Public Road Inquiries. Pl. XXXI, fig. 1, gives a view of this road, showing nearly one-fourth mile of it. Although no work has been done upon this road since its construction more than a year ago, it can be clearly seen that it is a good road. It is hard and smooth, except for slight depressions where the wheels have worn and packed the roadbed and where a central track has been formed by horses. This central track is due especially to the fact that carts are mainly used for hauling commodities, and to the further fact that the road was neither properly crowned when it began to dry nor kept in shape when finally packing and drying. This road needs only scraping and a little more sand added in places. It was made of sedimentary clay and ordinary sand. The clay had to be hauled a distance

FIG. 1.—GARNERS FERRY ROAD, 3.5 MILES FROM COLUMBIA, S. C., USED FIVE YEARS WITHOUT REPAIRS.

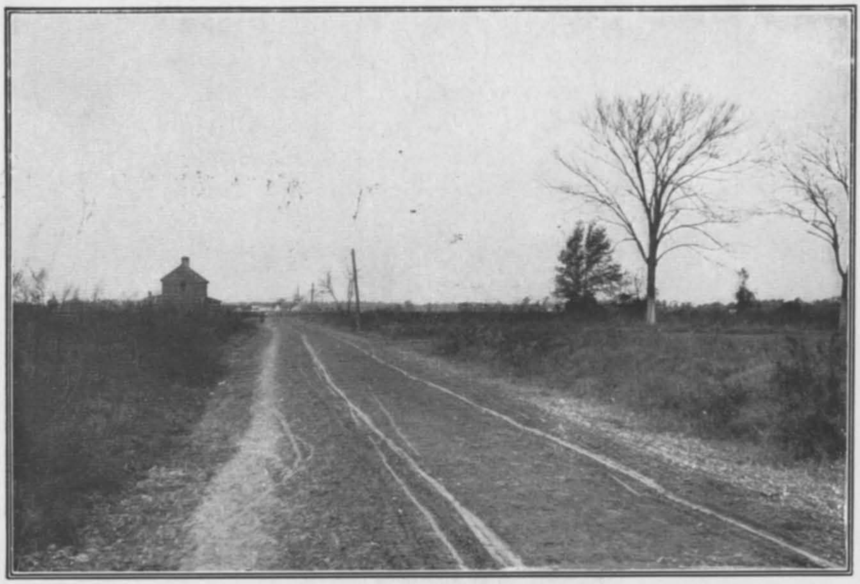


FIG. 2.—SAND-CLAY ROAD BUILT AT NEWBERN, N. C., UNDER THE DIRECTION OF THE OFFICE OF PUBLIC ROAD INQUIRIES.

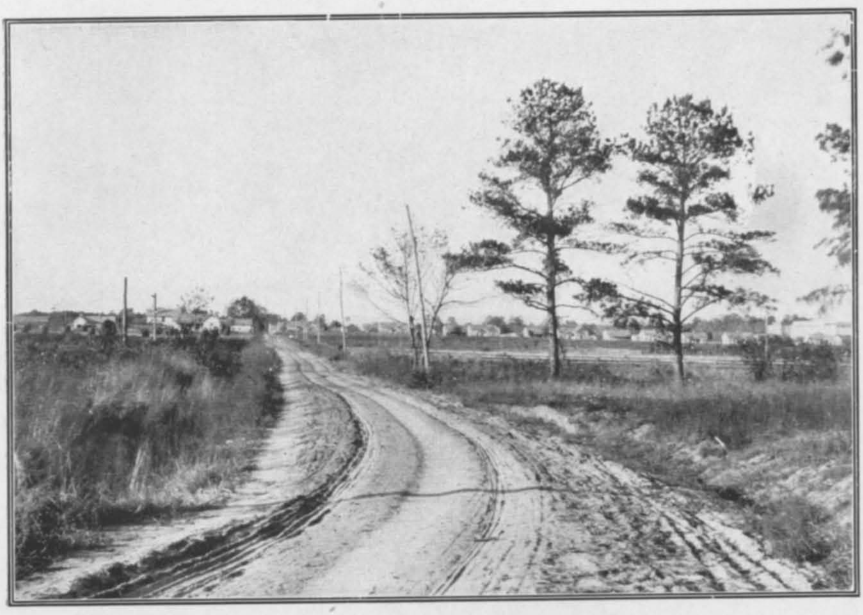


FIG. 1.—SAND-CLAY ROAD AT TARBORO, N. C.

[Nothing has ever been done to this road since it was constructed.]

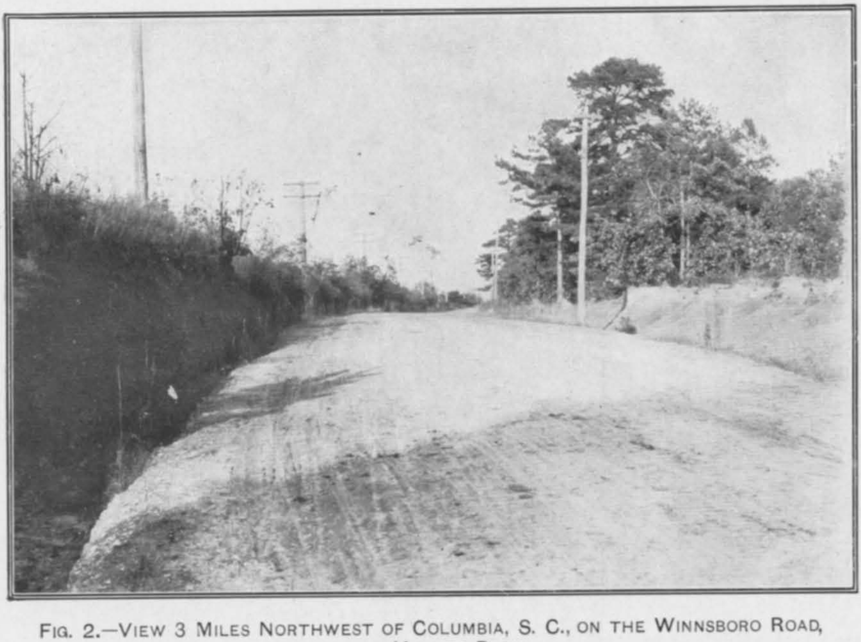


FIG. 2.—VIEW 3 MILES NORTHWEST OF COLUMBIA, S. C., ON THE WINNSBORO ROAD, NEAR HYATTS PARK.

of about one-half mile on an average. The grass and weeds which have grown up and filled the ditch show neglect. There are about 2 miles of this road, and a part of it became very muddy last winter and will become so again unless heavily sanded. This locality has loose sandy loam and very fine-grained sand, a part of which is free from loam. The latter will make in the end a good road, but patient, persevering effort is necessary to secure the best results.

The Newbern and Tarboro roads have been specifically pointed out because they show what can be done under maximum difficulties, being made of exceedingly fine-grained sand and sedimentary clays of poor binding qualities. The Columbia road shown (Pl. XXX, fig. 1) is made of an average quality of clay and sand, the former possessing good binding qualities and the latter being clean and fairly sharp. Another Richland County road is shown in Pl. XXXI, fig. 2. This is a section of the Winnsboro road about 3 miles from Columbia and near Hyatts Park. This road has been in use for more than five years without repair and presents a high degree of excellence, comparing favorably with the best macadam road in Mecklenburg County, N. C., in point of durability and utility. It is made of an excellent variety of ferruginous clay, water-worn quartz pebbles, and sand. The superior binding qualities of this clay, together with the sand, firmly embed the pebbles, and they are not displaced by the severest usage.

In a report on the roads of Richland County Mr. S. H. Owens, of Columbia, S. C., wrote as follows:

In reply to your letter of the 12th instant, requesting a detailed account of my experience in building sand-clay roads in this (Richland) county, I will say that the necessary quantity of sand on clay or clay on sand has to be determined by experimenting. When the road has been properly graded, and the roadbed is of sand foundation, the clay is spread evenly over the surface to a depth of from 4 to 6 inches, the depth depending on the percentage of sand in the clay. If the roadbed is of clay foundation, the sand is spread on a little thicker, say, from 6 to 8 inches. The clay or sand is simply spread on, not mixed, and the mixing is done by travel over the road, which is not interfered with while the road is in course of construction.

I find, after thoroughly experimenting, that sand on a clay foundation does not give as good results as clay on sand, on account of the drainage being insufficient under the roadbed, the clay not being as porous as sand.

As to the durability of the roads treated in this manner, I will state that roads which were built five years ago are in as good condition now as when built, and in some instances better. Of course, the roads have to be run over occasionally and repaired, which is quickly and easily done. Sometimes where there is much travel over the roads small holes will wear in them, owing to lack of clay or sand at that particular point. I find this to be the case near Columbia, where travel is necessarily greater than in the remote sections of the county. There are some roads in the county constructed five years ago that have had no repairs and are now in first-class condition.

We have about 400 miles of road built by the sand-clay method out of a total of about 650 miles in the county. These roads are giving perfect satisfaction and have stood the test of hard rains and constant travel. The cost of constructing roads by this method depends on the amount of grading to be done and the distance the sand or clay has to be hauled. The cost of repairs is very slight.

CONCLUSIONS.

The building of sand-clay roads has passed the experimental stage, and it is no longer a question of doubtful procedure. The important things to be borne in mind are thorough mixing to the saturation point, and then properly shaping and rolling the road. This mixing is usually done by the traveling public. This is the critical period in the construction of a sand-clay road, because care must be taken to secure an even amount of puddling, so that all the lumps of clay shall be broken and saturated with sand to a depth of 8 to 10 inches. If this can be done and the road is properly crowned as it dries, there can be no doubt about the result being eminently satisfactory. This mixing might be done by the use of plows and harrows when the clay is wet; but it is customary to let teams and vehicles accomplish it. It is true that the condition of the road becomes worse for a while during the puddling operation; but after this is effected and sufficient sand has been added relief is permanent.

In many portions of the Southern States the public roads are maintained by the old system of statute labor, which has been reduced, by the inefficiency of overseers, to little better than worthless. The mud which it is customary to throw on the roadbed is often a detriment, as it is the worn-out material from the road that has been gradually accumulating in the ditches. There are many sand-bars and gravel beds along the streams and rivers of the Piedmont section, where unlimited quantities of good sand and gravel may be found, a few loads of which would permanently heal the worst mudhole if it were to be first thoroughly drained. There is need of a general awakening along this line everywhere. An enormous waste of labor results, as stated, from the incompetency of many of the road overseers. Whether the overseers work statute labor, commutation labor, or hired labor, they should be able to so treat each particular case, deep sand or deep mud, as to effect a permanent cure.

PROMISING NEW FRUITS.

By William A. Taylor,
Pomologist in Charge of Field Investigations, Bureau of Plant Industry.

INTRODUCTION.

Notwithstanding the very strong tendency in recent years among commercial fruit growers in most sections to restrict their plantings to a few varieties of proved productiveness, beauty, and shipping quality, there are strong indications that an increasingly large number of growers are seeking fruits that combine these desirable features with distinctive flavor and superior dessert quality. The only way for the individual grower to keep pace with progress is to test the more promising kinds of the fruits in which he is specially interested; he can thus determine at small cost and with the least possible delay whether such sorts are adapted to his conditions and needs. It is for growers who desire to test such fruits that the series of descriptions and illustrations of promising new varieties published in the Yearbook from year to year is especially intended. It is believed that the varieties included represent the cream of the new sorts, selected with due regard to their adaptability to the representative fruit regions of the country.

The easiest and quickest method of testing new varieties of tree fruits is the well-known practice of top working. To test a new sort by this method it is only necessary to secure a scion or two of the desired variety for budding or grafting upon an established tree of bearing age which will constitute a suitable stock for the variety in question. As the budding or grafting of a single branch is usually sufficient for the preliminary test, a single established tree may in this way be made to carry a large number of new sorts. This plan has the further advantage of concentrating a comprehensive collection upon a small area of ground, and thus of reducing the cost of the experimental work to a minimum. To the amateur fruit grower it makes practicable the assembling of a much larger collection of varieties within the confines of a village or city garden than would otherwise be possible, and permits him to retain his touch with the continuous progress of fruit culture, even though he can not reside upon the farm or in the open country.

The results of a top-working test of a variety should never be accepted as final, however. Not infrequently varieties which make strong and thrifty growth when upon vigorous, well-established stocks develop weaknesses of root, trunk, or foliage when grown by budding or grafting upon the miscellaneous seedling stocks used in ordinary nursery practice. In some instances these defects are due to deficient vigor or too slender habit of growth; in others, to inherent inability to endure extremes of temperature or to resist injurious diseases or insect pests. The commercial orchardist, therefore, who desires to keep abreast with the rapidly advancing tide of new sorts should provide at the outset a small area of suitable land upon which he can plant from time to time two or more young trees of each new sort that gives indication of commercial value for his section. This is the practice now adopted by some of the most progressive commercial growers, and offers many advantages over the old way of planting heavily of new sorts untested in their region, many of which were destined to failure in some of the important characteristics that go to make up a really valuable commercial sort. Such a tree test is especially important with peaches and plums, where the commercial value of a variety often hinges upon the cold endurance of the trunk and the fruit buds, or the exact ripening period of the fruit with reference to older sorts already well tested in the region.

AKIN APPLE.

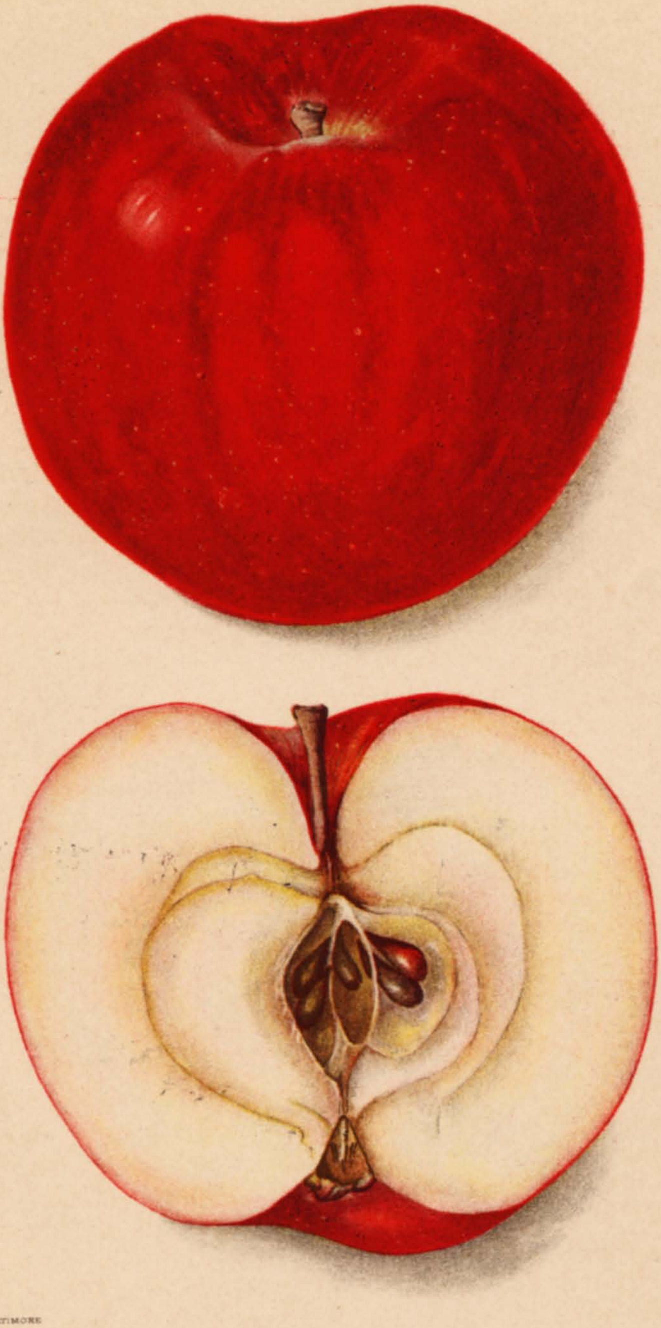
(SYNONYMS: *Akin Red; Akin Seedling; Akin's Seedling; Aikin's Red; Aiken; Aken*—not "Akin's Winter" of Downing, which is a crab of Minnesota origin.)

[PLATE XXXII.]

This promising commercial sort, unlike most American varieties of winter apples, appears to have been grown from planted seed. The original tree was grown from seed brought from Tennessee and planted in 1831 by Mrs. Matthew England, near Lawrenceville, Ill., on a farm now owned by Mr. W. J. Akin. Seventeen trees were grown from this lot of seed, but only the one described was considered worthy of naming and disseminating. It was first propagated for planting by Mr. John Akin, father of the present owner of the farm, who cut scions from the original tree for grafting in the nursery in 1861. Twelve of the trees grown in that year are still standing on the Akin farm. It was first propagated for sale by a Mr. Adams, a nurseryman in Wabash County, Ill., in 1868.[a] It appears to have been first catalogued in 1884, by Simpson and Hogue, under the name *Akin's Red*, and first illustrated in their catalogue in 1885.[b] In December, 1890, it was exhibited by Mr. W. J. Akin at the annual meeting

[a] Letters of W. J. Akin, Billett, Ill., January, 1904.

[b] Letter of H. M. Simpson & Sons, February 15, 1904.



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AKIN APPLE.

of the Illinois State Horticultural Society at Cairo, and was awarded first premium both as "Seedling" and as "New variety, good enough to be recommended," by a committee of which the late T. T. Lyon, of Michigan, was chairman.

The attention thus called to the variety caused it to be generally propagated by the nurseries in Illinois and nearby States, so that it was quickly given wide dissemination throughout the Middle West. It has now been fruited in several States, and is one of the most promising of the recently introduced sorts for the apple grower who desires a variety well adapted to the needs of the fancy fruit trade in the larger cities. It succeeds well in the Middle West and in the winter apple districts of the Allegheny Mountain region, and is worthy of thorough test on rich, warm soils in the northern apple districts from New York westward.

DESCRIPTION.

Form roundish, slightly ribbed; size medium; surface very smooth and glossy; color yellow, washed over almost the entire surface with bright crimson, showing some indistinct broad and broken stripes of dark crimson, sometimes overspread with gray; dots numerous, variable, but usually small, light russet and frequently indented; bloom whitish, rarely present at maturity of fruit; cavity of medium size and depth and gradual slope, somewhat furrowed and usually distinctly russeted; stem short to medium, length three-eighths to five-eighths inch, stout, usually downy; basin small, of medium depth and slope, slightly corrugated; calyx segments long, slender; eye small, closed; skin moderately thick, tenacious; core large, roundish, open, clasping the eye; seeds of medium size, plump, brown, numerous, 10 to 20; flesh yellowish, moderately fine grained, breaking juicy; flavor rather mild subacid, quality very good. Season, December to April or May; fruit enduring cold storage exceptionally well.

The tree is a strong, very upright grower, needing care in pruning to give the head sufficient spread. On this account it should be grafted low when used for top working, to counteract the well-known tendency of top grafts to run up. Though not so precocious as some, the tree appears to be a regular and good bearer, yielding a heavy crop of fruit, very uniform in size and appearance in alternate years, with lighter crops in the off years. The original tree in Lawrence County, Ill., stood until 1897, when it was blown down by a storm.

The specimen shown on Pl. XXXII was grown in the experimental orchard of the late W. S. Miller, Gerrardstown, W. Va., in the season of 1901.

TERRY APPLE.

(SYNONYMS: *Terry Winter; Terry's Winter; Terry Winter Pippin.*)

[PLATE XXXIII.]

In the gradual extension of apple culture southward from the regions where this popular fruit is recognized as thoroughly at home and in congenial adjustment with climatic conditions, fruit growers have long sought for varieties that would at the same time endure long summers and intermittent winters and yield fruit that would be comparable in keeping quality with that of the more northern winter varieties when grown in their native climes. A few early sorts, particularly those of Russian origin, such as Red Astrachan and Oldenburg, endure Southern conditions well, but long-keeping winter apples, of good dessert quality, adapted to the South, are few in number. Practically all that are now grown in a commercial way in the Coastal Plain and Piedmont regions of the South Atlantic and Gulf States are of American origin, most of them tracing to origins below latitude 37° N. Among such may be mentioned Shockley, Yates, and Hall, all of which have been found to succeed through a wide range of climatic and soil conditions in the South.

Of similar character and very promising for Southern apple growers is the Terry, which is illustrated on Pl. XXXIII. This variety appears to have originated as a seedling on the farm of a Mr. Terry, in Fulton County, Ga. Mr. Terry called the attention of a nurseryman, the late James Sneed, of Morrow, Clayton County, Ga., to the character of the tree and fruit, and in 1868 Mr. Sneed cut scions from it and began propagating it under the name "Terry Winter," planting 33 trees of the variety in his own orchard.[a]

In 1884 Mr. S. M. Wayman, upon settling at Pomona, Ga., found trees of the variety in a local nursery there, the stock of which had come from the Sneed nursery, in Clayton County. He was so much pleased with the variety when it came into bearing that he began propagating it on an extensive scale, both for planting in his own commercial orchard and for sale to other planters under the name "Terry Winter Pippin."[b] In 1885 Mr. W. D. Beatie found the variety in the Cole nursery near Atlanta, which he bought in that year. He continued to propagate it, and appears to have been the first to catalogue it—about 1885 or 1886. Since that time it has been very generally disseminated throughout Georgia and neighboring States. It appears worthy of general testing, both as a commercial variety and for the family orchard throughout the South and in similar warm regions where good keeping sorts of fine quality are few in number.

[a] Letter of J. C. H. Sneed, January 7, 1904.

[b] Letters of S. M. Wayman, December, 1899, and January, 1904.

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TERRY APPLE.

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HILEY PEACH.

Since 1892 the Terry has been listed in the "Catalogue of fruits of the Georgia State Horticultural Society" for culture in central Georgia, having been added to the catalogue upon the recommendation of the late Gustav Speth, then horticulturist of the Georgia State experiment station.

DESCRIPTION.

Form roundish to roundish oblique; size medium or slightly below; surface moderately smooth; color yellow, washed with mixed red, and brokenly striped and splashed with crimson, sometimes partially overspread with gray; dots numerous, of medium size, russet, many aureole; cavity regular, large, deep, abrupt, marked with russet; stem of medium length, one-half inch to 1 inch, slender; basin regular, of medium size, deep, abrupt, furrowed; calyx large, segments converging or erect, eye large, closed or partially open; skin thick, tenacious; core conic, oval, clasping, small, slightly open; seeds plump, brown, of medium size, 10 in number; flesh yellow, fine grained, crisp, juicy; flavor very pleasant, mild subacid; quality good to very good; season midwinter to March in Spalding County, Ga.

The tree is of slender, upright habit, very productive, and inclined to overbear. It needs thorough pruning and cultivation to hold the fruit up in size. The specimens illustrated in Pl. XXXIII were grown by Wayman and Riegel, Pomona, Ga., in 1901.

HILEY PEACH.

(SYNONYMS: *Hieley; Early Belle.*)

[PLATE XXXIV.]

One of the most promising of the newer varieties of the Chinese Cling group of peaches is the Hiley. This variety originated on the fruit farm of Hiley Brothers, Fort Valley, Ga. A row of about 150 seedlings was grown by them from mixed seed of Elberta and Belle, planted in 1889. Of these, the fruit of one tree which bore its first fruit in 1892 was considered desirable for market. The original tree was destroyed by borers two years after it bore its first crop of three peaches, but as buds had already been cut from it for propagation in orchard, the variety was preserved. Mr. R. A. Hiley, who first discovered its value, considers it a seedling of Belle, probably crossed with either Tillotson or Alexander.

The variety was christened "Early Belle," and the fruit was at first shipped under that name, but the name was later changed to Hiley, and it appears to have been first catalogued under that name by Mr. J. H. Hale, in 1900.

The Hiley has been heavily planted in Georgia as a commercial variety, and is especially commended as an early sort of good shipping quality and excellent flavor. It appears to be worthy of testing in

commercial orchards over a much wider area, where a white-fleshed freestone, ripening earlier than Mountain Rose, is desired.

DESCRIPTION.

Form roundish, often distinctly conical; size medium to large; surface smooth, well covered with soft, short, velvety down; color creamy white, with a bright crimson blush on the side exposed to the sun; cavity regular, of medium size, moderate depth, and abrupt slope; suture shallow except near cavity; apex usually sharp and prominent; skin rather thin and moderately tenacious; stone reddish, oval, long, sharply pointed, quite smooth, and rather small; flesh creamy white, usually slightly stained with red both near skin and near stone, rather firm though quite juicy; flavor slightly subacid, pleasant; quality very good for so early a variety; season about with Tillotson, June 15 to July 1 in Houston County, Ga. Reported by Mr. J. H. Hale to ripen about August 1 in Connecticut.

Tree rather slender in growth, with leaves narrower than its supposed parent, Belle; very productive, and considered equal to its supposed parent in hardiness; glands reniform; flowers large.

To the Hiley was awarded the Wilder medal of the American Pomological Society at the Boston meeting in September, 1903, upon the recommendation of the ad interim committee of awards, as a promising new variety.

WELCH PEACH.

[PLATE XXXV.]

In many portions of the country, where the climatic conditions during the growing season favor the development of peaches, the production of this delicious fruit is restricted by the occurrence of occasional low temperatures in winter. This is especially true of important districts in New England, New York, and the Lake region, the climate of which is favorable to peach growing if good varieties can be found that will endure occasional minimum temperatures of -10° to -15° F. in December, January, or February, when the trees are dormant. The earlier commercial orchards of those regions were planted with little reference to the fruit-bud hardiness of the varieties, the most popular sorts being of the Crawford and Oldmixon types. These succeeded well in favorable seasons, but usually failed when minimum temperatures lower than -10° F. occurred. The general failure of these varieties to produce regular crops aroused a very general interest in the development of hardy types of the peach throughout the North about thirty years ago. The occurrence of low temperatures over wide areas during the winters of 1872–73 and 1874–75 brought to light the fact that one of the types most resistant to winter cold was that which had been grown both in the form of budded trees and seedlings for many years in different sections of

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WELCH PEACH.

Connecticut, New York, and Michigan, under such names as *Connecticut*, *Stanley's Late*, *Sugar*, *Jenny Lind*, *Leopard*, *Queen of Sheba*, *Seagrove's Smock*, *Cass*, and *Hill's Chili*. The place, time, and source of the introduction of this type of peach to America are as yet undetermined, but it was frequently found to endure temperatures that destroyed the fruit buds of the other varieties in the same orchards, and thus achieved marked popularity among commercial planters in the regions mentioned. The form of the type that had long been perpetuated by a Mr. Hill, of Chili, Monroe County, N. Y., was very widely propagated and planted under the name "*Hill's Chili*," and soon became the leading commercial peach of the most northern peach districts. This variety or type reproduces itself through its seedlings quite closely, and for a number of years many nurseries in Michigan propagated their stocks of it for sale as seedlings. The resulting trees, when they came into bearing in the orchards, were chiefly of the "Chili" type, though several wide variations in color of flesh and time of ripening have come to notice, several of which, such as Lewis, Brown, Early Husted, and Early Michigan, have been named and propagated. Others, like Lafleur, that vary but slightly, are considered sufficiently superior to the parent in some important particulars to be worthy of a distinct name and place in the orchards.

The variety of this type to attain commercial notice most recently in western Michigan is the Welch, the original tree of which was received by Mr. Charles B. Welch, of Douglas, Mich., in 1880, in a bundle of 25 seedling "Chili," from the nearby nursery of Walsh and Wade. Of these 25 seedlings, all proved to be good typical "Chili" except the one now described, and one other, which was a good white-fleshed freestone. The tree of the Welch ripened its fruit noticeably later than the Chili, and was found to yield fruit of superior quality, as well as to be less subject to injury by curl-leaf and drought than its parent and equally as resistant to cold. At the request of Mr. Welch, a few trees were propagated from it by the late Mr. James F. Taylor, of Douglas, Mich., about 1888 to 1890, and its propagation and planting has gradually increased in western Allegan County since that time. It is considered equal to its parent in every respect and superior in habit of growth of tree, ability to endure drought and resistance to curl-leaf and rot, and ripens at a more opportune time, thus lengthening the season of supply of hardy varieties. So far as known it has not been fruited in other States than Michigan, but is considered worthy of test throughout northern peach districts.

DESCRIPTION.

Form roundish to slightly obovate; size medium to large; surface smooth, very slightly downy, color rich, rather light yellow, with a bright blush of red on the exposed side; cavity regular, medium in

slope and depth; suture shallow except at apex, which is minute, rarely projecting beyond the suture; skin rather thick and tenacious, slightly acid; stone small to medium, plump, oval, free; flesh light yellow, quite firm, yet melting and juicy; flavor sprightly subacid and vinous; quality good to very good, specially adapted to shipment and canning; season moderately late, a few days after Chili, about September 20 to 30 in Allegan County, Mich.

Tree a vigorous though rather slender, upright grower, rooting more deeply than Chili, and therefore enduring drought better, hardy and regularly productive; leaf glands large, numerous, reniform; flowers small.

The specimens illustrated on Pl. XXXV were grown by the late Mr. James F. Taylor, Douglas, Mich., in 1903.

SPLENDOR PRUNE.

[PLATE XXXVI.]

Among the prune growers of the Pacific coast the desirability of an earlier and larger variety of plum than the Agen (synonyms, *Petite*, *French*, etc.) suitable for curing into prunes has long been recognized. The prune-growing sections of the Old World, especially those of France, have been canvassed, and several more or less promising sorts now under commercial test have been secured within the past ten years. Meanwhile Mr. Luther Burbank has been at work upon the problem from the plant breeder's standpoint, and has produced at least two very promising varieties, "Splendor" and "Sugar," which are illustrated in Pl. XXXVI.

Splendor is stated by Mr. Burbank to have been grown from seed of the Agen, or common "French" prune of California, which was first introduced to California from France in the form of scions brought to San Jose in December, 1856, by Louis and Pierre Pellier. It was the result of a cross by Pond (synonyms, *Pond Seedling*, *Hungarian Prune*, *Grosse Prune d'Agen*, etc.), an English variety of large size that has long been grown throughout the plum-growing districts of the Northern and Eastern States. Splendor was first described and offered for sale by Mr. Burbank in his catalogue of "New creations in fruits and flowers" for 1893, where it was provisionally listed under the designation "Crossbred Prune A. P.-318." The original tree and the right to propagate and introduce the variety were purchased of Mr. Burbank soon thereafter by the Stark Brothers Nurseries and Orchards Company, who introduced it under the name "Splendor" in 1894. It is now under test in commercial orchards throughout the Domestica plum districts of the United States and Canada, and promises well as a shipping, dessert, and curing plum.

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1. SPLENDOR PRUNE. 2. SUGAR PRUNE.

DESCRIPTION.

Form oblong oval to obovate, with a rather distinct neck; size medium to large; cavity regular, small, shallow; stem medium to long; suture shallow, except near apex; apex very slightly depressed; surface smooth, glossy, purplish red, with minute russet dots and covered with a rather profuse bluish bloom; skin moderately thick and tenacious, slightly acid; stone small to medium, long, oval, free; flesh yellowish, translucent, with light veins, of meaty texture; flavor sweet and rich; quality very good; season about a week earlier than Agen in Sonoma County, Cal.

The tree is described by Mr. Burbank as resembling its female parent in general appearance, with more sturdy branches, abundantly vigorous and productive. The fruit hangs long to the tree, and objection to it has on this account been made by some prune growers, as it renders picking of the fruit from the tree necessary instead of shaking it to the ground. This characteristic should commend it to Eastern growers in sections where occasional high winds at ripening time damage the crop by shaking off and bruising.

The specimen illustrated on Pl. XXXVI was grown by Mr. Leonard Coates, at Napa, Cal., in 1902.

SUGAR PRUNE.

[PLATE XXXVI.]

This very promising seedling of Agen (synonyms, *Petite*, *French*, etc.) is not known to be the result of a cross with any other variety. It gives every indication of surpassing its parent in all the qualities that go to make up a first-class drying prune, being equal in all observed characteristics and superior in sweetness, size, earliness of ripening, and rapidity of curing.

The variety was named by Mr. Burbank, and appears to have been described first by the late B. M. Lelong in the preliminary report of the California State board of horticulture for 1897–1898. It was introduced by Mr. Burbank in the form of scions for grafting and a few two-year-old trees on peach roots in 1899. On account of its earliness, it quickly assumed commercial importance in the California prune districts, and has been top grafted on other prunes and on almonds to the extent of hundreds of acres in that State and in Oregon. Its behavior thus far marks it as the most promising curing prune yet brought to notice.

DESCRIPTION.

Form oblong to oval oblong or obovate; size medium to large (very large for the Agen class); cavity regular, medium in size, depth, and slope; stem short, rather slender, loosening easily when ripe; suture shallow, extending from cavity to apex; apex depressed; surface

smooth, dark purplish red with minute russet dots and rather slight bluish bloom; skin moderately thick, tenacious; stone medium to large, oval, cling; flesh yellowish, translucent, meaty, moderately juicy; flavor very sweet and rich; quality very good. Season about three to four weeks earlier than Agen in Sonoma County, Cal. The tests made by the chemist of the experiment station of California show this variety to be distinctly richer in sugar than Agen, while practical tests on a large scale have demonstrated its quick-curing character. Its large size (the dried fruit running 20 to 30 to the pound) renders it popular with consumers. On account of its earliness, it is considered especially promising for the prune districts of the Pacific Northwest, where untimely rains not infrequently interfere with the curing of the later varieties.

The tree is a more vigorous grower than its parent and a heavy bearer. It is considered by the originator to be less subject to injury by spring frosts than the parent variety.

The specimens illustrated on Pl. XXXVI were grown by Mr. Burbank on his trial grounds at Sebastopol, Cal., in the season of 1900.

HEADLIGHT GRAPE.

[PLATE XXXVII.]

One of the things long desired by Southern fruit growers is a good table grape, sufficiently resistant to leaf and fruit diseases to endure the climatic conditions of their section. Many varieties have been brought forward from time to time; but of the older sorts especially adapted to table use not one, either foreign or native, has yet proved successful over any large area. One of the most promising recent introductions in this field is the Headlight, which was originated by Prof. T. V. Munson, of Denison, Tex., in 1895. It is reported by the originator to be a seedling of Moyer—the result of a cross of Brilliant upon the former variety. Its desirable qualities of vigorous growth, disease-resistant foliage, productiveness, and early ripening render it worthy of thorough testing throughout the South.

It appears to have been described first by Professor Munson in the Catalogue of the Texas State Horticultural Society for 1899 in a tabular list of promising varieties not yet introduced. It was first disseminated commercially by the originator in 1901–1902.

DESCRIPTION.

Cluster cylindrical, small to medium, averaging about equal to Delaware, very compact and usually shouldered; berry small to medium, round, adhering firmly to pedicel; color dark red, covered with bluish bloom; skin moderately thick and tough, enduring handling without injury; pulp translucent, green, tender, juicy; seeds few, small to medium; flavor very pleasant, sprightly and vinous, without

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HEADLIGHT GRAPE.

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CARDINAL STRAWBERRY.

REDUCED TO FOUR FIFTHS DIAMETER.

foxiness; quality very good; season very early, ripening with Champion, and hanging long on the vine without deterioration in attractiveness or quality. It is also considered promising as a wine grape for the South.

The vine is vigorous, short jointed, and very productive, and so far as tested distinctly resistant to cold, having endured $-15°$ F. at Denison, Tex., without injury.

The specimen cluster illustrated on Pl. XXXVII is rather below the characteristic size. It was grown in the vineyard of Prof. T. V. Munson, at Denison, Tex., in 1903.

CARDINAL STRAWBERRY.

[PLATE XXXVIII.]

Since Hovey gave to the world his famous "Hovey Seedling" strawberry in 1834, there has been an almost unbroken succession of new sorts of this popular fruit. Differing widely as these varieties do in their important characteristics, it is now very generally agreed among fruit growers that no one variety has yet been produced or is likely to be developed that will excel all others in all the qualities that go to make up a desirable variety. The highest flavor and adaptability to culinary use are rarely found in the same sort, while ability to endure shipment well is still less frequently encountered in productive sorts of good color, size, and flavor. The varieties of greatest commercial importance at present are doubtless those that combine in largest degree fair size and productiveness with firm texture, attractive color, symmetrical form, good flavor, opportune season of ripening, and adaptability to a wide range of climatic conditions.

One of the most promising of the recently originated varieties that are now being tested in various sections is the Cardinal, which is illustrated in Pl. XXXVIII. This variety traces to one of a number of seedlings discovered by Mr. George J. Streator, of Garrettsville, Ohio, in 1896, in a portion of his vegetable garden where strawberries had previously been grown. These little seedling plants were carefully transplanted to a location where they could be brought into fruiting, and were held under observation for two years. The one afterward named "Cardinal" was from the start noticeably superior to the others in vigor of growth and healthiness of foliage, and when fruited was found to yield a good crop of very desirable berries. After several years of observation of its behavior, the originator secured plants of about 40 leading varieties and planted a trial bed for comparison, in which the Cardinal was found by capable judges in 1903 to surpass them all in vigor, productiveness, and other important market qualities on the clay loam soil in Portage County, Ohio, where the test was made. It is considered well worthy of testing by commercial growers throughout the country.

DESCRIPTION.

Form, roundish or roundish conical, occasionally slightly compressed and broadened, rarely necked; size, medium to large; surface, glossy, bright crimson, not fading; ripening evenly; seeds, small and mostly depressed; calyx, large, tenacious, pale green; flesh, quite firm and solid, salmon red, juicy, but apparently of good shipping quality; flavor subacid, sprightly, with distinct aroma; quality, good to very good, especially for canning; season, medium to late, closely following Bubach, about the first week in June in Portage County, Ohio.

The plant is pronounced a very vigorous grower, with foliage resistant to rust, and an abundant plant maker. The blossoms are imperfect. The fruit is borne on strong trusses and the variety is reported to be enormously productive.

The specimens illustrated on Pl. XXXVIII, reduced to four-fifths diameter, were grown by the originator, Mr. George J. Streator, at Garrettsville, Ohio, in 1903.

THE RELATION OF FORESTS TO STREAM FLOW.

By James W. Toumey,
Collaborator, Bureau of Forestry.

INTRODUCTION.

For the purposes of the present discussion "forest" must be understood to mean a growth of trees sufficiently dense to form a fairly unbroken canopy of tops, not a scattered growth of low, round-headed trees with bushes and herbage constituting the dominant types of vegetation.

Forests of this kind do not occur in the United States where the mean annual precipitation falls below 18 to 20 inches, except on restricted areas where unusual conditions prevail. The line of separation between the great eastern forest area and the plains approximately coincides with a north and south line marking a mean annual rainfall of 20 inches. The streams which rise in the Rocky Mountains and flow eastward are bordered by forests for long distances into the plains, where the annual rainfall is much less than 20 inches. These forests, however, are not so much a result of the rainfall in the regions where they occur as of surface and seepage flow from adjacent regions. The mesquite forests of the desert regions of southern Arizona, where the mean annual rainfall is but 8 to 12 inches, are made possible by the seepage and surface waters from the adjacent mountains.

The question of the exact relation which exists between forests and stream flow has long been under discussion. The broad fact that a relation exists is indeed indisputable. Forest destruction always produces a change in the character of the run-off. But the scientific determination of all the causes which produce this effect, and of their relative importance is a difficult and complicated matter. In spite of the fact that for many years European forest experiment stations have been carrying on observations, measurements, and experiments designed to clear up this subject, final conclusions covering the whole field have not yet been established. In this country almost nothing has ever been done to secure accurate data for the investigation of this problem as a whole. Some light, however, has been thrown on the subject by means of a series of observations which have been going on for several years in the San Bernardino Mountains in southern California. It is the purpose of the present article to make

clear what are the various factors entering into the problem, and to state some of the more important facts that these observations in southern California reveal.

In the San Bernardino Mountains records of precipitation for several years, at a large number of stations, show that differences in forest cover are closely correlated with differences in rainfall. This correlation is so close that it is possible to judge the mean annual precipitation with a fair degree of accuracy from the appearance of the forest alone. In these mountains forests cover the slopes wherever the mean annual rainfall exceeds 20 to 24 inches; however, on southern and western slopes forests of equal density represent a larger rainfall than on northern and eastern slopes.

Other things being equal, regions having the greatest rainfall bear forests of the greatest density and luxuriancy of growth; but where the mean annual rainfall falls below 18 to 20 inches, types of vegetation in which trees predominate are replaced by those in which shrubs and herbage predominate.

WHAT CAUSES RAINFALL.

Because rainfall is most abundant where forests grow, many believe that forests exert an important influence on the amount of precipitation. A more reasonable inference, however, is that *rainfall is the great factor in controlling the distribution and density of forests.*

Precipitation occurs whenever the air is suddenly cooled below the dew-point. The most effective cause of this is the expansion of air on ascending. This upward movement is caused very largely by cyclonic storms.

Whether forests have any appreciable effect in cooling the air to below the dew-point is uncertain. From the known effect of forests on the temperature and relative humidity of the air, it is reasonable to infer that they may have some such effect, at least to a small degree, and consequently that they have some influence in increasing precipitation. The present evidence, however, derived from many series of observations conducted in Europe and elsewhere, is so conflicting that a definite answer to this question, having the stamp of scientific accuracy, is not possible.

WHAT BECOMES OF THE RAINFALL.

That the excessive destruction of forests is followed by the drying up of streams and springs and by a diminution in the minimum flow of rivers is a well-established fact. The forest is the most effective agent known in regulating the disposition of the precipitation after it reaches the ground.

Rainfall escapes from the ground upon which it falls in five ways—through evaporation, transpiration, surface run-off, seepage run-off,

and deep seepage. By evaporation is meant the moisture which passes into the atmosphere in the form of vapor from water and soil surfaces and from objects resting upon such surfaces, including vegetation. Transpiration is that portion of the rainfall which sinks into the soil, and which is later taken up by the vegetation through the roots and given off to the atmosphere through the stems and foliage. To this latter should be added, although not actually a part of it, the comparatively small amount of moisture taken up by the vegetation, but which through chemical change becomes a part of the organic vegetable structure. By surface or superficial run-off is meant that portion of the precipitation which, from the time of falling until its exit from the drainage basin, passes over the surface without gaining access to the soil. On the other hand, by seepage run-off is meant that portion of the rainfall which sinks into the earth, but which later reappears on the surface at lower elevations, and with the surface run-off escapes from the drainage basin in the streams. By deep seepage is meant that portion of the precipitation which sinks into the soil, but to such depths that it does not reappear later on the surface of the drainage basin.

Evaporation and transpiration are frequently classed together as evaporation. In the irrigated parts of the West they are together known as "fly-off." So, also, the rainfall which does not escape through evaporation and transpiration or through deep seepage is often classed as run-off or stream flow.

DO FORESTS INFLUENCE EVAPORATION?

In order that the moisture which falls to the earth in the form of rain and snow should be most efficient in sustaining vegetation and in feeding streams, as little as possible should escape in the form of evaporation. Under the best of conditions a very large part of the annual rainfall is returned to the atmosphere through evaporation. For humid regions, bearing the same types of vegetation, the amount does not vary much from year to year, no matter what the fluctuations in rainfall are—a fact first made known by Messrs. Lawes, Gilbert, and Barrington in the classical Rothamsted investigations. These gentlemen explain this persistency in the rate of evaporation by the fact that heat and abundant rain seldom occur at the same time. Consequently, in a wet season, the lower temperature and more or less saturated atmosphere prevent excessive evaporation; while in a dry season, although the temperature is higher and the air drier, there is less water to evaporate, and the two extreme conditions balance each other so far as the amount of evaporation is considered. This is not true, however, in arid and subarid regions, because during years of minimum rainfall the upper layers of the soil are often so dry for months at a time that there is very little moisture to evaporate, while

on the other hand during years of maximum precipitation the atmosphere is not sufficiently saturated to check rapid evaporation.

There is little or no difference between evaporation from a water surface and from any other surface that is thoroughly wet, when both are exposed to the same atmospheric conditions. The evaporation from a water surface is, however, always the same under the same conditions, but it is not the same from other surfaces, because they vary from completely wet to completely dry.

In the forest the crowns of the trees remain wet but a short time after precipitation. During this period, however, the evaporation is undoubtedly very rapid, on account of the large surface and from the fact that the crowns are exposed to the wind and sun. But in a long series of investigations made at the Forest Experiment Station at Nancy, France, and recently published, it was found that a deciduous forest near that station held back from the ground less than 8 per cent of the total precipitation. Although this is almost immediately returned to the atmosphere in the form of evaporation, it is a comparatively small amount of the annual rainfall. On the other hand, evaporation from the soil in the open and in the forest continues often for long periods after the precipitation ceases. After the crowns become dry, evaporation is much retarded in the forest, because the forest floor is protected from the wind and sun. To such an extent is this true that the loss of moisture through evaporation is much less than that lost from an equally saturated soil or from a water surface in the open. Repeated European observations, extending over long periods of time, and shorter observations made in this country, conclusively show that evaporation from water or other wet surfaces on the floor of the forest is but one-third or one-fourth that from similar surfaces in the open. From the investigation of the moisture content of soils in the San Bernardino Mountains, the results of which are as yet unpublished, it appears that the first foot in depth of the mineral soil in the forest may contain two or three times as much moisture as soil of the same general character from similar situations in the open.

During the summer it is impossible to determine by actual measurement the loss of water from the soil either in the forest or in the open, because conditions as to moisture content constantly vary. During the winter, however, the evaporation from a snow surface can be measured with a fair degree of accuracy. Measurements made in the San Bernardino Mountains show that evaporation from snow surfaces may be four or five times as great as from water surfaces under similar exposure, and also that the rate of snow evaporation is profoundly influenced by the wind. In our Western mountains, where the snows are exposed to dry winds, the loss through evaporation is a large percentage of the total snowfall. In the San Bernardino Mountains, snowfalls a foot in depth are sometimes evaporated in two or three

days without even moistening the soil. In so far as forests check the winter winds and provide shade, they lessen winter evaporation. This lessening of the evaporation from snow surfaces, through the action of forests, is seen in the fact that snows linger much later in spring in well-wooded regions than in open areas.

It appears, then, that forests materially retard evaporation, both of soil moisture and of snowfall.

DO FORESTS INFLUENCE TRANSPIRATION?

When land is covered with vegetation a certain amount of the rainfall is taken up by the growing plants. A small part, through chemical change, becomes incorporated into the plant, but the larger part is returned to the atmosphere through transpiration. Although those who have investigated this subject are by no means in accord, there is reason to believe that considerable difference exists in the amount of water taken up by the different types of vegetation in the process of growth. On the whole, the forest probably takes up less water from the soil than the average agricultural crop. Risler, from a lengthy series of investigations, reached the conclusion that forests actually take up less than one-half as much water from the soil as the average agricultural crop.

The above would lead one to infer that where the soil, if not covered with forest growth, is clothed with grass or some other low form of vegetation, the return of moisture to the atmosphere, through evaporation and transpiration, or, in other words, the "fly-off," is less from the forest than from the open. But in regions having a short wet season followed by a long dry one the return of moisture to the atmosphere is probably greater from a forested area, because in the open for a large part of the year there is very little to evaporate, and the scanty growth of grass and other low forms of vegetation gives little opportunity for loss through transpiration.

THE INFLUENCE OF FORESTS IN REGULATING THE RUN-OFF.

Stream flow consists of both surface run-off and seepage run-off. Although these two can not be separately determined, total run-off admits of accurate measurement. Surface run-off may be considered as flood water, while seepage run-off is that portion of the drainage which gives the streams a sustained flow. It is evident that any factor which decreases the surface or superficial run-off and increases the seepage run-off is of the utmost importance in regulating the flow of streams.

The proportion of flood water to seepage is influenced by the rapidity of the rainfall. It is well known from direct observation that a slowly falling, prolonged rain, even on the naked soil of steep slopes, is all taken up by the soil. On the other hand, a heavy shower of short

duration, falling on the same slope, may largely escape as run-off. In the first instance each drop has time to be absorbed by the soil, while in the latter the accumulation of drops is more rapid than the absorption, and the excess moves over the surface to lower elevations. The forest canopy very perceptibly extends the period of time during which the rain reaches the soil, and in this way lessens surface run-off.

Again, forests, by checking the velocity of the wind and covering the mineral soil with a thick layer of dead leaves and other forest litter, effectively prevent soil transportation by both wind and water. On high elevations, where streams generally have their birth, the influence of the forest in this respect is of the utmost importance. So great is this influence that it exerts a marked effect upon topography. In mountainous regions particularly, the repeated destruction of forests permits the soil formed by the decomposition of the rocks at the sources of streams to be transported to lower elevations, with a consequent slow change in the details of the landscape. Such regions, if unforested, are apt to have precipitous slopes and scanty soil on the higher elevations. In that case there is no adequate medium to absorb the rain, and it flows over the surface. On the other hand, if such regions are well wooded, the slopes are less precipitous, and a considerable depth of soil usually covers the broad summits. As a result, the rain water is absorbed and the surface flow is reduced to a minimum.

Not only is it essential to have an adequate medium present to absorb the rain, but it must be of such character as to absorb quickly. The rapidity with which rain is absorbed is very largely governed by the physical properties of the soil, the organic litter upon it, and the vegetation. Decayed organic matter, by itself or in combination with mineral soil, absorbs moisture much more rapidly than soil containing little or no organic matter; hence, the greater the amount of leaf mold and other litter, the more rapidly will the rain be absorbed. Rapidity of absorption is also influenced by the degree of looseness of the mineral soil. In the forest the mulch of leaves and litter keeps the mineral soil loose and in the best condition for rapid absorption.

Not all the rain that is not absorbed by the soil where it falls reaches the streams by flowing over the surface. Much of it is taken up in passing from the place of falling to the stream. The amount taken up depends upon the obstructions in its pathway. Where there are no obstacles, as on barren ground, the moving water, by eroding channels, forms small rivulets, and these larger and larger ones, which flow with constantly increasing velocity. As a result, the water passes rapidly over the surface, and but little gets into the soil. When the soil is covered with obstructions, such as are offered by a forest with its accumulation of litter and vegetable growth, the rain which is not immediately absorbed is checked in its flow over the surface. The water, being held back, is finally taken up by the soil and thus prevented from forming small rivulets through erosive action.

The forest, in extending the time during which the rain reaches the soil, in its effect upon local topography, and in supplying a larger and better absorbing medium, must necessarily have a profound influence in increasing the seepage run-off, and in proportionately decreasing the surface flow.

COMPARISON OF RUN-OFF FROM FORESTED AND NONFORESTED AREAS.

There are so many complex conditions influencing the flow of streams that it is extremely difficult to determine the effect of forests on run-off by the comparison of the discharge of streams on forested and nonforested catchment areas. It is believed by many that stream flow is so largely influenced by the amount, intensity, and character of the precipitation, the configuration and area of the catchment basin, the character of the absorbing medium and the underlying rocks, and the general climate, as well as the forest itself, that we shall probably never be able to measure quantitatively the influence of forests on the flow of streams by the comparison of forested and nonforested regions. Catchment areas differ so greatly in the features mentioned above that our most conservative and able investigators have been forced to the conclusion that "in respect to run-off, each stream is a law unto itself." Although the above is probably in the main true, yet, by the careful selection of small catchment basins for comparison, it appears that the influence of the forest in diminishing the surface run-off can be determined with a fair degree of accuracy. When the catchment areas compared are in the same region, are influenced by the same or nearly the same climate and precipitation and by the same storms, have approximately the same configuration and area, and have a similar mineral soil and underlying rocks, the effect of these various factors on the run-off can be ignored, and the differences in the behavior of the stream flow on the forested and nonforested areas can be assigned to the influence of the forest.

In a careful study of the behavior of the stream flow on several small catchment areas in the San Bernardino Mountains, it has been found that the effect of the forest in decreasing surface flow on small catchment basins is enormous, as shown in the following tables, where three well-timbered areas are compared with a nontimbered one:

Precipitation and run-off during December, 1899.

Area of catchment basin.	Condition as to cover.	Precipitation.	Run-off per square mile.	Run-off in percentage of precipitation.
Sq. miles.		*Inches.*	*Acre-feet.*	*Per cent.*
0.70	Forested	19+	36–	3
1.05	....do	19+	73+	6
1.47	....do	19+	70–	6
.53	Nonforested	13–	312+	40

At the beginning of the rainy season, in early December, the soil on all four of these basins was very dry as a result of the long dry season. The accumulation of litter, duff, humus, and soil on the forest-covered catchment areas absorbed 95 per cent of the unusually large precipitation. On the nonforested area only 60 per cent of the precipitation was absorbed, although the rainfall was much less.

Rainfall and run-off during January, February, and March, 1900.

Area of catchment basin.	Condition as to cover.	Precipitation.	Run-off per square mile.	Run-off in percentage of precipitation.
Sq. miles.		*Inches.*	*Acre-feet.*	*Per cent.*
0.70	Forested	24	452+	35
1.05	.....do	24	428+	33
1.47	.....do	21	557+	43
.53	Nonforested	16	828+	95

The most striking feature of this table as compared with the previous one is the uniformly large run-off as compared with the rainfall. This clearly shows the enormous amount of water taken up by a dry soil, either forested or nonforested, as compared with one already nearly filled to saturation. During the three months here noted, on the forested basins about three-eighths of the rainfall appeared in the run-off, while on the nonforested area nineteen-twentieths appeared in the run-off.

Rapidity of decrease in run-off after the close of the rainy season.

Area of catchment basin.	Condition as to cover.	Precipitation.	April run-off per square mile.	May run-off per square mile.	June run-off per square mile.
Sq. miles.		*Inches.*	*Acre-feet.*	*Acre-feet.*	*Acre-feet.*
0.70	Forested	1.6	153−	66−	25−
1.05	.....do	1.6	146−	70+	30−
1.47	.....do	1.6	166+	74+	30+
.53	Nonforested	1	56+	2−	0

The above table clearly shows the importance of forests in sustaining the flow of mountain streams. The three forested catchment areas, which, during December, experienced a run-off of but 5 per cent of the heavy precipitation for that month, and which during January, February, and March of the following year had a run-off of approximately 37 per cent of the total precipitation, experienced a well-sustained stream flow three months after the close of the rainy season. The nonforested catchment area, which, during December, experienced a run-off of 40 per cent of the rainfall, and which during the three following months had a run-off of 95 per cent of the precipitation, experienced a run-off in April (per square mile) of less than

one-third of that from the forested catchment areas, and in June the flow from the nonforested area had ceased altogether.

DO FORESTS INCREASE THE RUN-OFF?

Owing to the very complex nature of the investigation involved in determining the effect of forests on the amount of run-off, the available evidence does not admit a definite answer that will be of general application. It is reasonably certain from present evidence that in some regions the effect of the forest is materially to increase the run-off. It appears equally certain, however, that in other regions, and on certain classes of catchment areas, the effect of the forest is to materially decrease the stream flow.

Mr. Rafter, in his recent publication, "Relation of rainfall to run-off," makes this statement: "With similar rainfalls, two streams, one in a region having dense primeval forests, the other in a region wholly or partially deforested, will show different run-off. The one with the dense forest will show a larger run-off than the stream in the deforested area." This author concludes, from the careful study of a large number of catchment areas in the State of New York, that the effect of the forest on at least a portion of the area studied is to increase the run-off to an amount equal to from 5 to 6 inches in depth over the entire catchment area.

In humid regions, where the precipitation is fairly evenly distributed over the year, and where the catchment area is sufficiently large to permit the greater part of the seepage to enter the stream above the point where it is gauged, the evidence accumulated to date indicates that stream flow is materially increased by the presence of forests.

In regions characterized by a short wet season and a long dry one, as in southern California and many other portions of the West, present evidence indicates, at least on small mountainous catchment areas, that the forest very materially decreases the total amount of run-off.

Annual rainfall and run-off on forested and nonforested catchment areas in the San Bernardino Mountains, California.

Area of catchment basin.	Condition as to cover.	Precipitation.	Run-off per square mile.	Run-off in percentage of precipitation.
Sq. miles.		*Inches.*	*Acre-feet.*	*Per cent.*
0.70	Forested	46	731	28
1.05	.....do	46	756	30
1.47	.....do	46	904	36
.53	Nonforested	33	1,192	69

On small nonforested catchment areas in the West, and possibly on large ones as well, a very large part of the heavy precipitation of the rainy season flows over the surface, quickly reaches the stream, and is discharged from the catchment area as flood water, much as water escapes from the roof of a building. On such areas the actual loss through evaporation during the dry season is probably far less than from a well-wooded area, because the surface soil and streams are dry and there is very little moisture left to evaporate. On such denuded areas it appears that the run-off for the few months that the streams flow is considerably larger than that for the entire year from similar forested areas. Although a nonforested area may, in certain instances, produce a larger run-off than a forested one, this probably never occurs except when the run-off from the nonforested area is largely flood water, and of destructive rather than constructive significance.

CONCLUSION.

In conclusion, it may be said that although the forest may have, on the whole, but little appreciable effect in increasing the rainfall and the annual run-off, its economic importance in regulating the flow of streams is beyond computation. The great indirect value of the forest is the effect which it has in preventing wind and water erosion, thus allowing the soil on hills and mountains to remain where it is formed, and in other ways providing an adequate absorbing medium at the sources of the water courses of the country. It is the amount of water that passes into the soil, not the amount of rainfall, that makes a region garden or desert.

DETERMINATION OF EFFECT OF PRESERVATIVES IN FOODS ON HEALTH AND DIGESTION.

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Reasons for the Investigations.

The Secretary of Agriculture is charged by law with the determination of the injurious effects which may be exerted upon health and digestion by preservatives, coloring matters, and other substances added to foods. It is important that decisions as to the effects of these substances shall rest upon indubitable evidence, which, in many cases, is not now at hand. To throw additional light on this subject an extensive series of experiments has been undertaken in the Bureau of Chemistry for the elucidation of some of the problems involved. In order that just decisions should be reached it was first necessary to eliminate, in so far as possible, all bias or prejudice concerning the matter. Nearly everyone has acquired, by reading the results of experiments or opinions, some definite ideas concerning the favorable or unfavorable action of these added substances, with many of which the consumer of food products is brought into daily contact. There may be cited, for instance, the coloring matter which is added to butter and cheese, sometimes to milk and cream, and the chemicals added to green vegetables (such as peas and beans), in order to produce and maintain a deep green color. The latter are usually salts of copper or zinc, generally copper. Of late, in preserved meats, in addition to the familiar preservatives which are at the same time condimental, such as sugar, salt, and wood smoke, there are found also such chemicals as borax or boracic acid, which have high preservative properties.

In specific cases the expert testimony which is available is often contradictory, and sometimes it is open to the suspicion of bias. In these cases inquiry elicits the fact that the testimony in question was obtained as the result of a specific employment of the expert by interested parties. This does not necessarily imply any lack of care or conscientious investigation on the part of the expert, nor does it impute to him any wrong motive, but it only takes into consideration the natural tendency of man to incline toward the side of a controversy in which he is chiefly interested.

For these and other reasons, it was deemed advisable to undertake a series of independent experiments in the Department of Agriculture, in a manner as thorough as possible, to obtain new data relating to the very important questions outlined above.

Methods of Experimenting.

In the specific case of preservatives added to food substances three lines of investigation may be followed.

In the first place, food products may be subjected to artificial digestion. In these experiments all the conditions of natural digestion, in so far as possible, are secured—the proper temperature, the proper subdivision of the food itself, the admixture of the digestive ferments, and the movements to imitate the peristaltic motions of the intestinal organs can all be provided for. A chemical study of artificial digestion will reveal in part the effect of the added preservatives upon human digestion. Most valuable data are secured in this way, and these studies have been thoroughly made by many different persons in widely separated localities. The only thing, however, which is determined by these experiments is the influence of the preservative upon the rate of digestion, and the question of the speed of digestion is not always the most important one. Within reasonable limits, the mere fact that one substance is digested more rapidly than another is no just cause for supposing that the former is more wholesome than the latter. It is, of course, evident that if the time of digestion be so prolonged as to endanger the processes of absorption and nutrition, such delay would work injury. If, on the contrary, only a moderate delay of digestion results, it may not in any sense diminish the total amount of food eventually absorbed for the nutrition of the body nor induce any disorder in the digestive organs themselves.

The second method in which the effect of these bodies has been studied is by feeding them under controlled conditions to the lower animals. The rabbit, the guinea pig, the dog, and even the chimpanzee and the monkey have been used for these purposes. There are many advantages to be noted in working upon animals of this class. In the first place, the effect of the mind upon the process is practically eliminated, as the animals are not supposed to know that their food has been changed in any way, inasmuch as the preservatives experimented with are usually of such a nature as to impart no perceptible taste or odor to the food to which they are added. One unfavorable condition is the confinement of the animals, since experiments of this kind can not be made upon animals allowed to go at large. Long confinement has its effects even upon the lower animals, and these effects may seriously interfere with the processes of digestion; hence impaired digestion resulting from these experiments may not be solely due to

the added bodies. On the other hand, the unrestricted range of experiments with the lower animals has some notable advantages, chief among them the fact that at the end of any given period of the experiment the animal may be killed and the condition of the internal organs carefully studied. It is undoubtedly true that often incipient disease of the internal organs may be induced by foods or substances added to foods without such effects being noticeable through ordinary observation; hence experiments might result in the declaration that any given substance was harmless, when, in point of fact, the foundations of serious and perhaps even fatal disease had been laid by it. It is evident, therefore, that the omission of experiments of this kind with the lower animals would be a grave mistake in experimental work.

In regard to both of these methods of experiments, it is only just to say that most careful and painstaking investigations have been carried out by competent observers, and the data which have been obtained are reasonably satisfactory. It, therefore, did not seem desirable to repeat in connection with the present investigations any of the experiments belonging to either of the classes mentioned.

Character of the Experiments Conducted by the Department.

The third method of experiment is that which both the others lead up to—namely, experiments with man himself. The important point in all researches of this kind is to determine what effect these substances have upon the health of man. It might easily be that a substance which is found to be innocuous to a lower animal would prove a serious menace to man, since the digestive organisms of animals differ very widely, not only among themselves, but still more widely among different species and genera. It is well known that some of the lower animals are immune from the effects of many substances which would speedily prove fatal to man. Thus, the crucial experiment in all cases of this kind must be with man himself. The difficulties, however, of experimenting with the human animal are exceptionally great. We have here to deal with a high intelligence, a perfect knowledge of the process which is going on, and a consequent factor of mental influence; the subject under study must be placed under an observation which is annoying, and, when long continued, becomes burdensome. Nevertheless, the importance of the work was of such a nature as to warrant its undertaking.

Experiments with the human animal in regard to the effect of preservatives and other substances added to foods are not new. They have been made by many observers for many years. A study of all the experimental data reveals the fact that generally the number of persons experimented upon at any one time has been very limited,

usually not exceeding two, and the time of observation has been relatively short, rarely exceeding ten or fifteen days. It seemed highly desirable, therefore, in the conduct of work of this kind, to increase the number of persons under observation, and especially to lengthen the time of the experiment. The facilities at the disposal of the Bureau of Chemistry permitted experimental work to be carried on with at least twelve persons, and that was the number finally selected.

SELECTION OF THE EXPERIMENTAL CLASS.

In the selection of the subjects it was necessary, of course, to call for volunteers, and during the work of the fiscal year ended June 30, 1903, they were taken almost exclusively from among the employees in the Department of Agriculture. A full statement of the nature of the experimental work was placed before each candidate, so that no misconception of the character of the life which they were to lead could arise. Among the applicants, the number of which was far greater than could be included in the experiment, a selection was made first with regard to the use of alcoholic beverages. It was deemed advisable, at least in the first series of experiments, to secure volunteers who were not in the habit of using alcoholic beverages of any kind, and in the number selected no one was included who regularly indulged in the use of these beverages. Respecting the use of tobacco a more liberal policy was pursued. No one was selected, however, who used tobacco to excess, and among the few candidates who did use it those were taken who agreed that during the progress of the experiments they would use tobacco regularly, in constant quantities, at regular hours, and continue to use the same kind during the whole period. Thus, any possible disturbance which might be due to the tobacco would be eliminated, as such disturbance would be a constant one, pervading all periods of the experimental work.

In the conduct of this work it was also fully realized that the difficulty of controlling so large a number of individuals by any system of espionage was insurmountable. Young men, therefore, of reliable character were taken and were placed upon their honor to observe rigidly all the rules established for the conduct of the work. The candidates signed an agreement to follow explicitly the rules and regulations governing the hygienic table during their attendance thereon. While at the table of observation they agreed to use no food nor drink other than that provided, with the exception of water, and any water drunk away from the table was to be measured and reported daily as a part of the ration. They further agreed to continue as members of the hygienic table for a period of at least six months from December 1, 1902, unless prevented by illness, accident, or other

unavoidable circumstance. The regulations specified that regular habits of life were to be pursued, no unusual exercise or labor indulged in, and if tobacco were used it was to be in such quantities and at such times as the subject and the chief of the Bureau of Chemistry should agree upon. It was also agreed that neither the Department of Agriculture nor any person connected therewith should be held responsible for any illness or accident that might befall the subject during his connection with the hygienic table. At the completion of each experimental period, in retiring from the observation table and passing to the recreation table, each member was required to sign a form certifying that he had fulfilled these requirements in every particular and had to the best of his ability recorded accurately the data relating to weight, temperature, pulse, and all items of food and drink received.

This feature of the work was undertaken with the full knowledge that any violation of these pledges on the part of a subject under examination would introduce very misleading data into the results. It is evident, however, that any marked variation from the schedule of life laid down for each one of the young men under observation would reveal itself in such a way in the analytical data as to attract attention, and even to arouse suspicion. Thus, the analytical data obtained from the foods eaten and from the excretions of the body constituted a reasonably reliable check upon the honesty of the individual and the fidelity with which he observed the regulations imposed.

FEATURES OF THE EXPERIMENTS.

The food of each member of the class was weighed or measured. The liquids, such as coffee, milk, tea, and water, were measured, and their weights calculated from the density of the solutions. Samples were taken of each kind of food served with each meal, in order that a complete chemical control of the food supply might be secured. The sample of food, immediately after being taken, was placed in a bottle, stoppered, and sealed with melted paraffin, so that no moisture could escape from the sample during the necessary interval of time before the analysis could be accomplished. In the same manner the excreta from each member were carefully collected, weighed, and subjected to analytical study. In the collection of these excreta in the way described there is necessarily a small percentage of loss; it is fair, however, to presume that such losses would be uniformly distributed throughout the whole of the observation period, and that the errors would be both of a plus and minus nature, and therefore mutually compensatory throughout a long period of time.

By this system of analysis it may be said that an account was opened with each individual, who was charged with all that he received and

credited with all received from him, the difference being credited to profit and loss. There are some elements of the food which are practically all secured in the excreta after having passed through the functional activity in the body for which they are particularly designed. It may occur as an objection to this form of experiment that the excreta which are secured in any one day or few days do not represent the actual foods which have been consumed in that time in their entirety. This objection is without doubt well taken. For instance, the nitrogen recovered to-day may have entered the body many days, or even weeks, previously in the food; and the same is true of the phosphoric acid. But, in point of fact, in the equilibrium which is found to exist in the healthy body, the quantity of nitrogen or phosphoric acid excreted in a given day represents very accurately the amount ingested. For instance, if one were to take a long tube filled with marbles and put another marble in at one end, one is forced out at the other end, and thus the equilibrium is restored. So in a body in a state of equilibrium, if 15 grams of nitrogen are ingested in the food an equivalent quantity is excreted.

An accurate record was kept of the temperature of the body ascertained by a standardized clinical thermometer before and after dinner. The weight of the body was determined each day by use of a delicate balance, which would easily indicate a difference of 10 grams when weighted with a man of ordinary size. A record of the pulse was also made twice a day, and any variations from the ordinary functional activities of the body carefully noted.

PERIODS OF THE EXPERIMENTAL WORK.

The experimental work in each case was divided into three periods—a fore, a middle, and an after period. During the fore period, by experimental determination there was ascertained the quantity of a well-balanced ration which would maintain the body in a state of practical equilibrium, so that there was but little, if any, gain or loss of weight. The quantity of the ration having thus been determined during a period usually of about ten days, the subject was required to live upon that exact ration during the remaining two periods.

During the middle period there was added to the food a given quantity of a preservative. During the first year the preservatives employed were borax and boracic acid. The middle period was divided into subperiods of about five days. The amount of preservative used at first was small, and was then increased until practically the limit of toleration was reached—that is, until a quantity was given which manifestly produced discomfort, distressing symptoms, or positive illness. The effects of this substance upon the digestive process were

carefully noted by the changes which took place in the proportions of the elements of ingested food and of the excretions.

After the middle period, which ranged from fifteen to sixty days, the members of the class entered upon the after period, during which time the same quantity of food was given, with, however, the omission of the preservative. The object of the after period was to restore the body, at least partially, if the equilibrium had been disturbed, to the state of equilibrium in which it was found at the time the middle period began. Thus, each subject at the end of all the periods, if possible, was left in practically the same state of health in which he was at its beginning. All the data obtained in this way, therefore, became valuable in determining even minute effects produced upon digestion, health, and the general metabolic processes.

DIETARY OF THE CLASS.

In the following table are shown the character and amount of foods eaten by the members of the experimental class during a part of one period. The table illustrates not only the variations in the amount of foods which are eaten, but also the fact that the bodily weight is not always an index of the amount of food consumed, though, in general, the larger the bodily weight the greater the amount of food required for its proper sustenance.

Amount of food consumed daily in relation to weight of subject.

[January 28 to 31, 1 gram borax per diem.]

NUMBER ONE.

Date.	Weight of subject.	Soup.	Fish.	Meat.	Vegetables.	Cereals.	Bread.	Butter.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	56.46	165	....	140	300	125	300	75
January 29	56.60	170	....	150	175	30	271	90
January 30	56.57	207	187	....	300	100	238	75
January 31	56.12	200	....	150	300	30	254	60
Average	56.44	186	187	147	269	71	266	75
Total	....	742	187	440	1,079	285	1,063	300
Ratio	....	1.31	0.331	0.780	1.90	0.505	1.88	0.532

Date.	Weight of subject.	Sugar.	Water.	Tea.	Coffee.	Milk.	Dessert.	Total weight of food.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	56.46	10	300	....	450	1,135	200	....
January 29	56.60	10	500	....	450	1,032	200	....
January 30	56.57	10	....	....	450	826	200	....
January 31	56.12	....	700	....	450	826	200	....
Average	56.44	10	500	....	450	955	200	....
Total	....	30	1,500	....	1,800	3,819	800	12,041
Ratio	....	0.053	2.66	....	3.19	6.77	1.42	21.33

Amount of food consumed daily in relation to weight of subject—Continued.

NUMBER TWO.

Date.	Weight of subject.	Soup.	Fish.	Meat.	Vegetables.	Cereals.	Bread.	Butter.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	66.80	165	....	150	350	125	225	45
January 29	66.80	170	....	160	350	30	225	45
January 30	66.70	207	192	....	350	100	225	45
January 31	65.90	200	....	160	400	30	193	45
Average	66.55	186	192	157	362	71	217	45
Total	....	742	192	470	1,450	285	868	180
Ratio	....	1.11	0.289	0.706	2.18	0.428	1.30	0.270

Date.	Weight of subject.	Sugar.	Water.	Tea.	Coffee.	Milk.	Dessert.	Total weight of food.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	66.80	150	100	203	428	1,342	100	....
January 29	66.80	170	300	203	450	1,259	200	....
January 30	66.70	165	300	203	450	1,238	200	....
January 31	65.90	130	....	203	450	1,342	200	....
Average	66.55	154	233	203	444	1,295	175	....
Total	....	615	700	812	1,778	5,181	700	13,973
Ratio	....	0.924	1.05	1.22	2.67	7.79	1.05	21.00

NUMBER THREE.

Date.	Weight of subject.	Soup.	Fish.	Meat.	Vegetables.	Cereals.	Bread.	Butter.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28 [a]	....	....	....	40	75	150	85	15
January 29	51.21	170	....	115	125	40	318	45
January 30	51.05	207	142	....	200	100	261	45
January 31 [b]	50.80	....	....	....	75	40	97	15
Average	51.02	188	142	78	119	82	190	30
Total	....	377	142	155	475	330	761	120
Ratio	....	0.739	0.278	0.304	0.931	0.647	1.49	0.235

Date.	Weight of subject.	Sugar.	Water.	Tea.	Coffee.	Milk.	Dessert.	Total weight of food.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28 [a]	....	....	....	....	225	444	....	....
January 29	51.21	....	400	....	450	1,238	200	....
January 30	51.05	20	400	....	450	1,032	200	....
January 31 [b]	50.80	....	600	....	450	619	....	....
Average	51.02	20	467	....	394	833	200	....
Total	....	20	1,400	....	1,575	3,333	400	9,088
Ratio	....	0.039	2.74	....	3.09	6.53	0.784	17.81

[a] Only one meal, breakfast.
[b] No lunch, out of experiment, after February 1.

Amount of food consumed daily in relation to weight of subject—Continued.

NUMBER FOUR.

Date.	Weight of subject.	Soup.	Fish.	Meat.	Vegetables.	Cereals.	Bread.	Butter.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	67.99	165	....	150	350	125	347	75
January 29	68.05	170	....	160	350	30	360	90
January 30	68.25	207	192	....	350	100	300	105
January 31	68.10	200	....	160	350	30	300	75
Average	68.10	186	192	157	350	71	327	86
Total	....	742	192	470	1,400	285	1,307	345
Ratio	....	1.09	0.282	0.690	2.06	0.419	1.92	0.507

Date.	Weight of subject.	Sugar.	Water.	Tea.	Coffee.	Milk.	Dessert.	Total weight of food.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	67.99	50	....	203	450	1,238	200	....
January 29	68.05	20	200	203	450	1,238	100	....
January 30	68.25	45	400	203	450	1,238	200	....
January 31	68.10	10	....	203	450	1,238	200	....
Average	68.10	31	300	203	450	1,238	175	....
Total	....	125	600	812	1,800	4,952	700	13,730
Ratio	....	0.184	0.881	1.19	2.64	7.27	1.03	20.16

NUMBER FIVE.

Date.	Weight of subject.	Soup.	Fish.	Meat.	Vegetables.	Cereals.	Bread.	Butter.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	66.70	165	....	150	350	125	258	60
January 29	66.70	170	....	160	350	30	272	45
January 30	66.95	207	192	....	350	100	252	45
January 31	66.62	200	....	160	400	30	246	45
Average	66.74	186	192	157	362	71	257	49
Total	....	742	192	470	1,450	285	1,028	195
Ratio	....	1.11	0.288	0.704	2.17	0.1127	1.54	0.292

Date.	Weight of subject.	Sugar.	Water.	Tea.	Coffee.	Milk.	Dessert.	Total weight of food.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	66.70	90	....	203	335	1,238	200	....
January 29	66.70	80	200	203	335	1,238	100	....
January 30	66.95	70	200	203	335	1,238	200	....
January 31	66.62	70	400	203	335	1,032	100	....
Average	66.74	78	267	203	335	1,186	150	....
Total	....	310	800	812	1,340	4,746	600	12,970
Ratio	....	0.464	1.20	1.22	2.01	7.11	0.899	19.43

Amount of food consumed daily in relation to weight of subject—Continued.

NUMBER SIX.

Date.	Weight of subject.	Soup.	Fish.	Meat.	Vegetables.	Cereals.	Bread.	Butter.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	62.32	165	....	150	350	125	300	60
January 29	62.58	170	....	160	350	30	267	60
January 30	62.25	207	180	....	350	100	244	60
January 31	62.19	200	....	160	400	30	263	60
Average	62.34	186	180	157	362	71	268	60
Total	....	742	180	470	1,450	285	1,074	240
Ratio	....	1.19	0.289	0.754	2.33	0.457	1.72	0.385

Date.	Weight of subject.	Sugar.	Water.	Tea.	Coffee.	Milk.	Dessert.	Total weight of food.
1903.	*Kilos.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
January 28	62.32	60	....	....	450	1,238	200	....
January 29	62.58	50	200	....	450	1,238	200	....
January 30	62.25	50	200	....	450	1,238	200	....
January 31	62.19	50	400	....	450	1,238	100	....
Average	62.34	52	267	....	450	1,238	175	....
Total	....	210	800	....	1,800	4,952	700	12,903
Ratio	....	0.337	1.28	....	2.89	7.94	1.12	20.70

COMPOSITION OF THE FOODS.

In the table following is shown the composition of foods as they came upon the table, giving the percentages of the different components thereof, and also their heat-forming value. As is well known, one of the chief functions of food is to furnish heat and energy, and the constituents of food which are the most active in this respect are the fats, sugars, and starches. The nitrogenous elements of food, known as protein, also furnish heat and energy, but have a particular function in nourishing the muscular and other nitrogenous tissues of the body. The phosphorus and sulphur which exist in foods in the organic form are most important constituents of our food products, since both these mineral elements are essential to nutrition. The phosphorus is found to enter, in organic form, many tissues of the body, and in an inorganic form is one of the chief constituents of bones. The sulphur also enters into the organic constitution of the body, being a very important ingredient of the protein of the muscles and other tissues.

Analyses of foods.

Serial No. (moist).	Meal, date, and description of food.	Composition of fresh substance.							
		Solids.	Combustion.	Water.	Nitrogen.	Phosphoric acid.	Sulphur.	Fat.	Ash.
		Per ct.	Calories.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
	Breakfast, March 20.								
3819	Bread	77.13	3.29	22.87	1.82	0.230	0.056	0.333	0.63
3820	Eggs	33.96	2.40	66.04	2.31	.534	.275	17.06	1.35
3821	Potatoes	19.75	.805	80.25	.311	.114	.041	.148	2.11
3822	Oatmeal	24.03	1.07	75.97	.643	.215	.052	2.25	.41
	Lunch, March 20.								
4364	Bread	71.88	3.07	28.12	1.70	.214	.055	.311	.62
	Soup, chicken broth	2.48	.126	97.52	.24	.086	.007	.15	.84
	Apple sauce	31.85	1.312	68.15	.06	.023	0	0	.18
	Dinner, March 20.								
4365	Bread	72.31	3.09	27.66	1.71	.215	.055	.312	.62
4366	Shad	46.02	3.29	53.98	3.37	.576	.194	25.30	1.36
4367	Potatoes	20.48	.835	79.52	.323	.118	.043	.154	2.09
4368	Peas	14.07	.660	85.93	.623	.134	.037	.534	.93
4369	Cornstarch	30.34	1.42	69.66	.507	.223	.043	2.41	.75
	Breakfast, March 21.								
4370	Bread	71.75	3.06	28.25	1.70	.213	.056	.310	.62
4371	Sirloin steak	47.94	3.37	52.06	4.23	.496	.270	21.14	1.25
4372	Potatoes	20.99	.855	79.01	.331	.121	.043	.157	2.09
	Grapenuts	94.69	4.05	5.31	1.95	.76	.096	.809	1.87
	Lunch, March 21.								
4403	Bread	74.03	3.16	25.97	1.75	.220	.056	.320	.63
	Gumbo soup	8.68	.410	91.32	.45	.074	.007	.17	.87
	Peaches	31.67	1.30	68.33	.045	.038	.005	0	.33
	Dinner, March 21.								
4404	Bread	73.99	3.16	26.01	1.75	.220	.056	.320	.62
4405	Roast lamb	40.78	2.71	59.22	4.49	.484	.235	13.69	1.64
4406	Potatoes	20.21	.824	79.79	.319	.116	.043	.152	2.09
4407	Beans	7.12	.322	92.88	.274	.062	.048	.115	1.54
	Peaches	31.67	1.30	68.33	.045	.038	.005	0	.33
	Soup, beef	13.00	1.07	87.00	.242	.104	.010	11.38	.87
	Breakfast, March 22.								
4408	Bread	73.00	3.12	27.00	1.73	.217	.056	.315	.63
4409	Eggs	32.05	2.35	67.95	2.24	.567	.272	16.16	1.16
4410	Potatoes	19.30	.785	80.70	.304	.111	.045	.144	2.09
	Korn Krisp	92.83	3.89	7.17	1.48	.360	.109	1.07	2.49
	Lunch, March 22.								
4411	Bread	73.07	3.12	26.93	1.73	.218	.057	.316	.66
	Consommé	3.34	.171	96.66	.34	.066	.006	.15	.78
	Apple sauce	31.85	1.312	68.15	.06	.023	0	0	.18
	Dinner, March 22.								
4412	Bread	71.24	3.04	28.76	1.68	.212	.056	.308	.64
4413	Chicken	49.27	3.30	50.73	4.99	.524	.280	17.98	1.23
4414	Potatoes	18.74	.762	81.26	.295	.108	.044	.140	2.10
4415	Peas	14.54	.682	85.46	.646	.140	.037	.555	.93
	Peaches	31.67	1.30	68.15	.06	.023	.005	0	.33

CHARACTER OF CHEMICAL WORK.

In the table below is shown the method of establishing the relation between the nitrogen ingested and the nitrogen excreted. As will be seen, in most instances, the amount of nitrogen ingested is larger than that recovered, because a considerable quantity of the nitrogen enters into the hair, nails, and skin, whose external portions are constantly thrown off. This quantity of nitrogen, of course, is not included in that which is obtained from the excreta. The balance sheet, therefore, usually shows a loss of nitrogen, but for the purposes of our comparison we may assume that the degree of loss is practically uniform through all the periods of observation, and, therefore, that any disturbance in the relations which exist between the amounts of ingested and excreted nitrogen are due under controlled conditions to the substances added to the foods.

Nitrogen balance, subject No. 7.

PRELIMINARY PERIOD.

Date.	In food.	In feces.	In urine.	In feces and urine.	Balance.	Total eliminated.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per cent.*
April 24 to May 1	123.72	8.688	118.77	127.458	−3.738	103.0
May 2 to 5	76.06	5.600	68.71	74.310	+1.750	97.7
May 6 to 9	73.32	6.483	67.33	73.813	− .493	100.7
May 10 to 13	75.38	6.04	66.28	72.32	+3.06	95.9
May 2 to 13	224.76	18.123	202.32	220.443	+4.317	98.1

PRESERVATIVE PERIOD.

Date.	In food.	In feces.	In urine.	In feces and urine.	Balance.	Total eliminated.
May 14 to 17	72.85	5.525	67.42	72.945	− 0.095	100.1
May 18 to 21	76.97	5.28	66.41	71.69	+ 5.28	93.1
May 22 to 25	74.43	5.73	69.70	75.43	− 1.00	101.3
May 14 to 25	224.25	16.535	203.53	220.065	+ 4.185	98.1
May 26 to 29	75.06	5.58	69.71	75.29	− .23	100.3
May 30 to June 2	58.80	3.918	52.61	56.528	+ 2.272	96.1
June 3 to 6	79.40	5.95	72.02	77.97	+ 1.43	98.2
May 26 to June 6	213.26	15.448	194.34	209.788	+ 3.472	98.4
June 7 to 10	75.27	5.87	65.79	71.66	+ 3.61	95.2
June 11 to 14	75.11	6.67	69.96	76.63	− 1.52	102.0
June 15 to 20	113.58	10.50	101.76	112.26	+ 1.32	98.8
June 7 to 20	263.96	23.04	237.51	260.55	+ 3.41	98.7
May 2 to June 20	926.23	73.15	837.70	910.85	+15.38	98.4

AFTER PERIOD.

Date.	In food.	In feces.	In urine.	In feces and urine.	Balance.	Total eliminated.
June 21 to 29	150.34	14.87	125.29	150.16	+0.18	99.9

The following table shows the same relation between the phosphoric acid ingested and that secured in the excreta:

Phosphoric acid balance, subject No. 9.

PRELIMINARY PERIOD.

Date.	In food.	In feces.	In urine.	In feces and urine	Balance.	Total eliminated.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per cent.*
February 10 to 27	30.35	8.066	19.44	27.50	+2.85	90.6
PRESERVATIVE PERIOD.						
February 28 to March 3	10.93	2.505	7.66	10.17	+0.76	93.0
March 4 to March 7	14.51	3.613	9.30	12.91	+1.60	89.0
March 8 to March 11	12.83	3.064	9.24	12.31	+ .52	95.9
February 28 to March 11	38.27	9.182	26.20	35.39	+2.88	92.5
AFTER PERIOD.						
March 12 to March 19	26.02	6.665	14.29	20.91	+5.11	80.4

The above tables are given only as samples to show the character of the chemical work involved in the study of so complicated a problem. It is evident, however, that even though the problem is complicated and difficult of attack and solution, we must rely upon investigations of this kind to reach decisions of a practical character on which the policy of the official in charge of the inspection of food products may be based.

CONCLUSIONS.

The detailed discussion of the data obtained in this experiment, together with the conclusions derived therefrom, will be found in a bulletin of the Bureau of Chemistry soon to be issued. Some of the more salient points, however, which are brought out by the experiment may be mentioned:

(1) The addition of small quantities of borax or boracic acid to the food of healthy subjects, even for a considerable period, extending in some cases to fifty days, produces a slight disturbance in the digestion and assimilation of the food.

(2) In larger quantities the effect produced upon different individuals varies. In some cases large quantities are tolerated with apparently little inconvenience, while in other cases, when the amount given daily reaches 2 or 3 grams, somewhat profound disturbances of normal conditions are developed. These disturbances are manifested by a feeling of depression and discomfort, attended very frequently by a dull and continued headache, with a sense of fullness in the head. In

no instance, even when large doses were administered, did either borax or boracic acid produce any pronounced symptoms of diarrhea or diuresis.

(3) When pushed to the limit of toleration the quantities of the borax or boracic acid which produce nausea, vomiting, and loss of appetite vary greatly with the individual. In some cases these symptoms were produced by from 3 to 4 grams daily, while in other instances these quantities could be tolerated.

(4) The elimination of the added borax or boracic acid is accomplished mostly through the kidneys. The merest traces of the ingested substances are found in the feces, and considerable quantities in the perspiration.

(5) The effect of the added preservatives upon the metabolic processes is of such a character as to be properly discussed only in connection with the analytical data relating thereto, and this discussion will be found in the proposed bulletin.

(6) By reason of the different degrees of susceptibility to the influences of these added substances manifested by different individuals, it is evident that it is impossible to foretell in any given case what effect may be expected. For this reason the protection of those more sensitive to the influences of these preservatives seems to be a wise and just measure. Hence, without concluding from this experiment that the use of boracic acid and borax in food products should be absolutely prohibited, it is evident that if they are employed proper notice of the fact should be given to the consumer, either on the labels of the packages or otherwise.

USE OF WEATHER BUREAU RECORDS IN COURT.

By Henry J. Cox,

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INTRODUCTION.

The use of Weather Bureau records in the adjudication of legal claims is constantly increasing, and their value as evidence is now fully realized in all sections of the country. It is indeed difficult to form an idea, even approximately, of the number of times weather reports have been of service in such matters, as the great majority of the cases never reach the courts, but are settled without trial. The information desired is often furnished by letter, and still more frequently persons come to the office personally for it, or call up by telephone. The monthly meteorological summaries are mailed regularly to the claim agents of many railroads, and attorneys prominent in personal-injury litigation are often listed to receive them. This monthly summary, issued by each Weather Bureau station at the end of each month, contains a statement of the local weather conditions, such as the highest and lowest temperature, rainfall, and state of weather for each day, and comparative data for similar months for many years previous. At the largest stations this form is printed, while at the smaller ones it is issued by the milliograph process. In Chicago alone 225 persons regularly receive the summary, and 125 extra copies are printed and held in reserve for applicants for data. After three or four years this supply is generally exhausted.

METHODS PURSUED IN INTRODUCING WEATHER RECORDS IN COURT.

The method pursued in producing a record of the weather in court varies. It is accomplished in one of three ways: (1) By presenting a written statement or printed report of the Weather Bureau office; (2) by introducing a certified copy; (3) by a summons, requiring the attendance, with the weather records, of the official in charge of the office.

Written statements or printed reports are seldom admitted as evidence, as their introduction must be through an agreement of counsel on both sides. Should any objection be raised a different

method must be followed. However, in some localities in Pennsylvania, Nebraska, Louisiana, and Texas transcripts of records prepared by the observers are frequently accepted as evidence.

Certified copies of the records can be issued from the central office at Washington, D. C., alone, and then only under the seal of the Department of Agriculture. The original records from all stations are forwarded at the end of each month to the office of the chief of Bureau, and it is therefore possible for him to prepare a certified copy of the records, showing the weather conditions which prevailed at any time in the past in any city in which a station is maintained. The data in this form are admissible in any court in the land, and the demand for these records is considerable. In the year 1902 alone the central office at Washington City issued 130 certified copies of weather records for use in court.

It more frequently happens, however, that the official in charge of a local station is summoned, or called by agreement with counsel, to produce certain of his records in court. This method is most generally followed, as it is more convenient and delays are avoided. It often happens that an attorney does not know before the trial of a case that he will need the weather records, and in such an event certified copies could not be procured from Washington in time. Again, it is often necessary that the records be explained, and the attorneys usually desire to ask questions of the observer outside the records, even sometimes requiring expert testimony. It has been said that the mere presence of the weather man on the witness stand frequently adds strength to the evidence under consideration. In the great cities of the country work of this character forms an important part of the duties of the Weather Bureau officials.

FREQUENCY OF RECORDS IN COURT.

An effort has been made to ascertain the number of times observers of the Weather Bureau have appeared with the records in court during the past ten years. The data in many cases are incomplete, and frequently the figures are not exact. The total number of reported cases is 2,834. No definite information could be secured relative to the number of times storm-warning displaymen and voluntary observers appeared in court. It is safe to say, however, should these be included, that the number of personal appearances in ten years far exceeds 3,000. Some of the individual figures are as follows: New York City, 301; Chicago, 255; Buffalo, 167; Philadelphia, 166; Boston, 158; Kansas City, 153; Detroit, 102; Albany, 89; Cleveland, 58; Louisville, 53; Cincinnati, 52; a number of other cities, from 20 to 43 each.

The record shows a gradual increase of personal appearances required from year to year. In 1902 the total number of cases at all stations was 348, or over 12 per cent of the entire number for ten years. The

following are some of the figures for that year: New York City, 48; Chicago, 45; Boston, 26; Kansas City, 22; Philadelphia, Buffalo, Cincinnati, Detroit, New Haven, Pittsburg, Denver, and Charleston, 6 to 14 each. There has been a marked increase in the figures reported by the largest cities during the past five years, New York and Chicago each showing a gain of more than 100 per cent during the period.

Ordinarily the frequency with which the records are produced should be expected to depend upon the size of the cities in which the stations are situated. The geographical location, however, is important, snow, ice, and freezing weather figuring largely in the matter. There is consequently greater demand for weather data for this purpose in Northern than in Southern States. Again, personal-injury suits based on insufficient grounds are more frequent in some localities than in others.

ADMISSIBILITY OF RECORDS AS EVIDENCE.

While in some localities ordinary transcripts of the records are admitted as evidence, the practice is not common. The records retained at the stations are usually considered competent, whether they are originals or copies, provided they are brought into court by the custodian or other authorized official and introduced in the proper manner. Generally, all that is necessary for counsel to show in laying the foundation for their introduction is that the records are official and were kept in the ordinary course of business, and that they are present in court in the hands of the custodian. Very few courts require the original record to be submitted or the observer in whose handwriting the record was made to testify.

The United States Supreme Court decided more than twenty-five years ago that a record of the weather kept by an observer was competent evidence in a court of law, and many State courts have handed down similar decisions. Yet, in some States the question has not been passed upon by the highest tribunal. Only recently the supreme court of the State of Missouri decided that press copies of meteorological forms are admissible, and a case is now pending in the court of appeals of Illinois in which it will be decided whether a press copy of the daily weather journal be competent. It is not strange that courts should differ in these matters. In fact, there is frequently much difference between the decisions of judges upon other subjects, where cases are apparently analogous.

CHARACTER OF SUITS INVOLVED.

Evidence as to the weather is a factor in a great variety of cases, both civil and criminal. The civil cases are largely personal injury, damage to perishable goods by freezing or rain, and loss by fire. The criminal cases are usually confined to murder trials. The claims for damages to perishable goods are almost always settled outside of

court, information as to the existing weather conditions having been secured by both sides, and exact data as to damage done and the liability of the carrier being understood. In personal-injury cases, however, the chances for settlement are not as favorable, especially as a great many of these suits are unwarranted, the plaintiffs often having no just claim whatever. It is believed that of all the cases where weather records are produced in court by observers 90 per cent at least are in personal-injury cases, and generally in the interests of the defendant corporations or municipalities.

PURPOSE OF INTRODUCING RECORDS.

It is quite possible for an official of the Weather Bureau to appear in court with the records and give testimony without knowing the character of the suit on trial. The observer may even not know what the attorney is endeavoring to prove by his records and evidence. Attorneys generally arrange to put him on the stand immediately upon his arrival in court, and he is excused after his testimony has been given.

The writer was once called into court to testify as to the velocity of the wind, the attorney thinking a velocity of 18 miles per hour to be high. Some attorneys seem to be ignorant of many well-known meteorological facts, but there are many lawyers practicing who have had the weather records in court so often that they have a complete understanding of them and a considerable knowledge of meteorology. These men are generally connected with municipalities, railroads, and street railways, and they are constantly engaged in personal-injury litigation. When accidents occur by reason of a street car running into somebody or something, the question arises as to whether the rails were slippery so that the car could not be stopped. This fact is, of course, important in an action for damages. A slippery rail can be caused by "sweating," but it is generally due to recent rain. Often, even when the rainfall has ended several hours before the accident, the relative humidity and other atmospheric conditions may be such as to prevent evaporation of the moisture or "drying up" of the rail.

An observer was once called in a case in which it was alleged that the plaintiff had been injured by being pitched through the open window of a car. It was claimed that on account of the raw, cold weather the plaintiff, a woman, was endeavoring to shut a window as the car reached a curve, and she was suddenly thrown headlong into the street. The railway introduced the weather record to show that it was a warm, sunny, and pleasant day, and that there was no occasion for shutting the window.

Evidence as to the existence of snow and ice is often very important in showing that the street and sidewalks were slippery. It is contended that litigants often bring suit for injury alleged to have been received in falling off a street-car platform or step, when, as a matter of fact,

the injury was incurred in slipping on the icy ground, after having safely alighted from the car.

"An icy street or sidewalk" is frequently the defense of a municipality when claim is made that an injury has been caused through a defective sidewalk. In such a case the argument is frequently advanced that the plaintiff slipped and fell on the ice rather than into a hole, as claimed. This is what is generally known as a "snow-and-ice defense."

The defendants more frequently call the observer into court, as the records seem more generally to suit their side, yet it is exceptional now that both sides are not fully informed as to the weather and character of the streets at the time of the accident. The testimony of the observer, therefore, is usually no surprise to the lawyer on the opposite side; because if he has properly prepared his case, he has already been advised of the weather conditions shown by the official record. It may be said that both sides secure the information, and then if it has any particular bearing one or the other attorney calls the observer. It has happened that both sides have summoned the official in the same case, each apparently seeing an advantage.

Occasionally the weather records are desired in court when the weather itself may have had no direct influence on the accident. In such an event the testimony is of value simply to disprove the evidence given by the witness on the other side. For instance, on cross-examination persons may state that the weather was clear and warm, whereas the records may show that it was snowy or rainy and cold. Careful lawyers, as stated, generally go into such matters with their witnesses before placing them on the stand, because if it is shown that a single false statement has been made, the entire testimony of the witness is invalidated. It has been said that evidence given by an observer, absolutely impartial as he must be, is sufficient to nullify the statements to the contrary made by a dozen prejudiced witnesses.

The visibility of the atmosphere has an important bearing upon many lawsuits. The condition of the air, whether foggy, snowy, rainy, or smoky, often figures extensively in the trial of cases where collisions occur either on land or water. The question often arises whether there was light enough to see a path or a hole in the street, or some obstruction. An observer is often asked to state as an expert the strength of light prevailing under certain conditions. In criminal trials such testimony is often desired.

The wind records are often used during trials involving damage by wind, such as the blowing down of buildings, superstructures, and flagstaffs, the wrecking of vessels on the lakes and ocean, etc., and seldom is a suit for damage, caused by high wind, tried in any of the large cities that the weather records are not called into court. In marine disasters, due to stress of weather, it is important to know whether storm warnings were displayed before the vessels left port. Should the warnings of the storm have been especially pronounced,

and vessel masters advised to remain in port, responsibility for catastrophe would surely rest with the ship's company.

During a severe thunder squall one afternoon in the summer of 1890 a large pleasure barge was wrecked in Long Island Sound. Several persons lost their lives and many suits against the owners of the boat resulted. They were tried in a United States circuit court. There was no Weather Bureau station in the immediate vicinity of the accident. The Weather Bureau records from New Haven, Conn., across the sound, showed that the squall was felt there very severely, but in New York City, on the other side and a little farther away, the storm did not attain to any great force. The observer in charge of the New Haven station was summoned by the defendants with his records, and he found on arriving at court that the observer in New York City had been called to testify for the other side. One attorney had endeavored to apply the New Haven conditions to the scene of the accident, while his opponent claimed that the weather in New York more nearly applied. As these storms in summer are local, neither record could be of much value, but the instance is referred to in order to show under what circumstances the weather records are sometimes produced in court. In twenty years' service it is the only instance when the writer found a worker in his own field on the other side of a case in court.

The direction and velocity of the wind have also an important bearing upon losses by fire as well, when it is claimed that the fire originated from an engine, or some other avoidable cause. A suit for many thousand dollars was once brought by the owners of some property in Chicago against a railroad company, the claim being that the sparks from one of the engines set the fire. The Weather Bureau records, however, showed that there was a brisk wind blowing directly away from the property and toward the railroad, and the matter seemed so plain to the presiding judge after the observer had testified that he ordered the jury to bring in a verdict for the defendant.

Frequently, during windstorms signs are blown down and injuries inflicted on passers-by. Most serious disasters have occurred through the force of the wind, and it may be desired to show that no one is responsible for the injuries received in such cases, but that the calamity was due to an act of Providence.

The act of Providence (the legal term being *actus Dei*) is indeed the favorite argument heard in many trials, whether it be the overflowing of a sewer through extraordinary rainfall, or the cessation of building operations on account of prolonged wet weather, or severe cold. In all such cases the weather man is needed. Probably no claim for injuries received through the falling of a building in the track of the St. Louis tornado or the Galveston flood would receive attention in any court of law. Suits for damages received in storms of less severity, but of great violence, often reach the courts, and the defendant

endeavors to show that the accident occurred through no fault of his, but through conditions beyond human control. There is, of course, a point beyond which human effort can not go. When accidents occur in spite of all care and endeavor they can be blamed to no one. The line of demarcation is not well defined. Evidence introduced to the effect that the accident occurred during an unusual and even remarkable storm always has much weight with the jury.

Evidence is sometimes desired in case of damage by lightning. Several years ago a building in Illinois collapsed during a severe thunderstorm. It was insured against loss by lightning, but not against loss by wind. The owner claimed full insurance on the ground that the destruction of the house was caused by a bolt of lightning. The matter was placed in the hands of an adjuster, and he in turn called to his assistance a professor then in charge of one of the principal Weather Bureau offices. By mutual consent the decision was left to this official.

The subject of rainfall was important in a peculiar way in a trial in Connecticut several years ago. A burglary had been attempted one night in a prominent residence, and the occupants believed that they recognized as the intruder their own coachman, who lived near by in the stable. A thunderstorm with heavy rain prevailed at the time, and shortly afterwards the officers who had been summoned put the coachman under arrest. He denied the charge and called attention to the fact that his shoes were not wet and muddy. During the trial the weather records were produced, showing heavy rain at the time, and the jury concluded that it was a case of mistaken identity, and the prisoner was discharged.

IMPORTANT INSTANCES WHERE RECORDS HAVE BEEN USED.

The storm which wrecked the city of Galveston on September 8, 1900, afterwards passed northward with greatly diminished energy. On reaching Kansas it began to redevelop and gain new strength, and after changing its course toward the northeast it was centered, on the morning of September 11, over Iowa. On that day it crossed the Great Lakes with hurricane force, causing considerable damage to shipping and other property along its track. The wind reached an extreme velocity of 90 miles per hour at Chicago. The gale carried away the top of a freight car and laid it down on a railroad track before an express train which was passing at the time. A bad wreck resulted, and all the cars left the track, but on account of the sandy soil no serious injuries were reported. But one suit for damages was filed against the railroad on account of this wreck. At the trial the writer appeared with the wind records of the Chicago Weather Bureau station. He was required to trace the track of the storm from Galveston to the Lake region, the purpose of the attorney for the

railway plainly being to impress upon the minds of the jury that the storm which caused the accident was the "Galveston storm," and in this he was apparently successful, as a verdict of "not guilty" was returned. In this case no actual wind observations were taken within 40 miles of the scene of the accident, but the observer was able to state, basing his information upon the general conditions as shown by the telegraphic observations, that the storm was probably as severe at the place of the wreck as at Chicago.

In April, 1902, a storm moved over the Middle Western States, attaining at Chicago about the same velocity as the more noted storm of September, 1900. At one place in Indiana the wind reached such force during the night as to start in motion an empty box car standing on a railway siding. The car was carried onto the main track and ran for 2 miles without being observed, owing to the darkness. It finally collided with a passenger train, and a very bad accident occurred, several persons being killed and a number wounded. The writer recently appeared with the records as a witness in behalf of the railway company in one of the suits which resulted. The railway company did not hope to escape a penalty in this case, as it was shown that the derailing switch had permitted the car to pass from the siding to the main track. It was simply expected that the evidence as to the severity of the storm would lessen to some extent the amount of the damages awarded by the jury, and in the effort some measure of success was gained. In such cases a witness is obliged to say more than what is actually stated in the record. He must state whether conditions reported as prevailing at the observatory were, in his opinion, the same 1 or 40 miles distant.

Voluntary observers' reports, usually being in every county, are occasionally used in court to show the character of the weather, and they have been accepted as evidence in the courts of Chicago when produced by the writer. Several times through these reports data have been prepared and produced as to the temperature along the route of shipment of perishable freight from 1,000 to 3,000 miles in length.

Not until recently did the writer appear in court in a case in which damage to crops was alleged. In a suit which was tried in October, 1903, the defendant endeavored to show that the constant and heavy rains in the Middle Western States interfered with harvesting and spoiled the plaintiff's crop, and that there was no manipulation of the market.

Weather Bureau records have figured in some of the most notable murder trials. An observer was called by the defense in a murder trial in order to show that the night the victim disappeared was dark and threatening. It was expected that this evidence would contradict that given by two witnesses for the prosecution, who testified that

they, although distant several hundred feet, saw the accused take the victim into a factory. Testimony of this nature is used in connection with the identity of alleged criminals, and observers are even asked occasionally whether under certain conditions it would be possible to identify or see a person. Such opinions are most difficult to give, and a conservative official will be very slow in venturing an opinion in such a matter if the ground appears to be debatable.

In another murder trial evidence as to temperature only was introduced by the prosecution. It was desired to show that it was possible to keep the body of the murdered man for a month in midwinter without attracting attention. It was shown that the weather certainly was cold enough, as the temperature was near zero during the entire period.

Reference has been made in this paper only to cases of which the writer has special knowledge, but the weather records have been used during recent years in many other notable trials.

EXPERT TESTIMONY.

An observer is frequently called upon to say what, in his opinion, would be the effect when certain conditions prevailed—perhaps to estimate the pounds pressure during a gale of wind against a car or the side of a building. He may even be asked for an opinion as to certain matters that can not be definitely calculated, such as the pressure against every part of a huge banner stretched across the street, where the complications are so many that estimates are valueless. The opinion of the meteorologist is sought not only as to the character of the conditions, but also as to their effect, whether the phenomena were unprecedented or extraordinary, and how frequently they had previously happened. A comparison between the unusual and the average conditions is often made. The position of a Weather Bureau official in such matters is consequently very important, as he must give his evidence with great care. He must be absolutely unbiased and thoroughly fair to both sides.

Upon the competency of the observer, both as regards technical knowledge and his acquaintance with climatic peculiarities, depends the value of his interpretation and amplification of the records he is called upon to produce. He must be able to apply the data in his possession to the needs of the particular case upon which he is in attendance; and above all he must maintain entire self-possession and self-confidence when subjected to searching examination and cross-examination that is often made with a view to test the value of his evidence as an expert in meteorological science.

Such work is not objectionable, and intelligent service on the witness stand is a distinct gain to the Weather Bureau and to the community. The truth is what is desired, and weather observers have doubtless

often performed in courts of law important and valuable service in discrediting manufactured evidence by stating the facts as observed without any fear of controversion. The relations between the judiciary and the bar on the one side and the Weather Bureau on the other seem to be mutually agreeable. The value of the Weather Bureau records is appreciated, and thorough cooperation is acknowledged. With the increase in the number of observing stations and more comprehensive and complete meteorological data at hand, the weather service will naturally be a still more important factor in the settlement of claims and the trial of suits in which the question of the weather in any of its phases enters.

INSECT INJURIES TO HARDWOOD FOREST TREES.

By A. D. Hopkins,
In Charge of Forest Insect Investigations, Division of Entomology.

Extent of Damage Determined by Special Investigations.

Within recent years the writer has conducted investigations in the principal hardwood forests of the country for the purpose of determining the extent and character of damage caused by insects, and especially that which results in direct losses to the owners, manufacturers, and consumers of hardwood forest products. This resulted in finding that oaks, chestnut, hickories, maples, birches, walnuts, cherry, tulip or yellow poplar, gums, and others of our principal hardwood, or broad-leaved, timber trees are damaged to a far greater extent than is realized by the casual observer. A large percentage of the hardwood timber in nearly all of the States east of the Rocky Mountains is affected, and the average annual losses from this source we would estimate at between 15 and 20 million dollars. There is not only a direct loss to owners of forests, and manufacturers and consumers of forest products, but the continued depredation is contributing to the rapid depletion of the available hardwood timber supply of the country.

The Character of Insect Injuries to Living Forest Trees.

The character of insect injuries to living forest trees may be discussed under two distinct heads:

(1) Injuries which cause the death of the trees.

(2) Injuries to the wood which do not materially affect the vitality of the trees, but cause serious defects in the parts which furnish commercial products.

There is also great loss from insect injuries to felled timber, saw logs, round and square timber, lumber, and other crude products, but the limited space allotted here will not permit a discussion of this phase of the subject.

INJURIES WHICH CAUSE THE DEATH OF TREES.

The principal insect injuries which result in the death of trees are burrows through and beneath the living bark of the trunks. There are two distinct classes of these injuries, one caused by bark-boring beetles, the other by bark-boring larvæ or grubs.

INJURIES BY BARK-BEETLES.

The adults of this class of enemies bore into and beneath the bark for the purpose of excavating galleries in which to deposit their eggs. These galleries are the primary injury which weakens the vitality of the trees, while the secondary or larval mines complete the girdling process which kills them.

INJURIES BY BARK-BORING GRUBS.

This class of injuries is caused by larvæ which hatch from eggs deposited by the adult insects in the outer bark, and never in burrows beneath it; therefore the burrows made through the living inner bark by the young not only cause the primary injury, but complete the girdling process.

The form of the burrows or galleries is, as a rule, sufficient to identify at once the class to which a given injury belongs, and very often is sufficient to identify the insect.

Bark-Beetle Injuries to Hickory Trees.

Within recent years the dying of hickory trees has attracted considerable attention, especially in the northern tier of States, from Wisconsin to Vermont. The trouble also extends southward through the Atlantic and Eastern States as far as central Georgia and westward to Missouri. Thousands of trees have died, and in some sections nearly all of those in forests, parks, and on farms have perished. This is causing a serious loss not only of a valuable timber product, but of shade trees and the crop of nuts, which latter, in some sections, is of considerable importance, both as a commercial product and for home consumption. This dying of the hickories has been found in every case investigated to be the result of injuries to the buds and twigs and to the bark of the branches and trunks by the hickory bark-beetle (*Scolytus 4-spinosus* Say).

THE HICKORY BARK-BEETLE.

The hickory bark-beetle is a short, stout, shining black or reddish-brown beetle, averaging 3.6 millimeters (0.14 inch) in length. The wing covers are short and project over the abdomen, which in the males is excavated beneath and armed with four rather prominent

spines, which suggest its technical name. It appears on the wing from May to August and begins its attack on the living trees at the base of the buds and leaves, apparently for the purpose of obtaining food; later it enters the bark of the larger branches and top of the trunk and excavates short longitudinal burrows (fig. 27, *a*) in the inner bark and surface of the wood. The eggs, which are placed along the sides of this primary gallery, hatch into small white grubs, or larvæ, which burrow at right angles through the inner bark and groove the surface of the wood (fig. 27, *b*). The broods of larvæ pass the winter in these brood galleries, and the transformation to the adult takes place in the spring in the outer portion of the inner bark. The adults emerge through holes in the outer bark (fig. 29) to continue their depredations on the buds and branches of other trees and the remainder of the trunks that were not killed by the first attack. They commence to emerge about the middle of May in the latitude of Morgantown, W. Va., and two or three weeks later in the latitude of Detroit, Mich. Individuals of the hibernating brood continue to emerge until August, and may be found excavating galleries and depositing eggs as late as September. Thus, they will be found attacking trees all through the summer, and all stages, from very young to matured larvæ, will be found in the bark at the commencement of winter. In the States north of Tennessee and North Carolina there is evidently but one generation, while farther south there may be two.

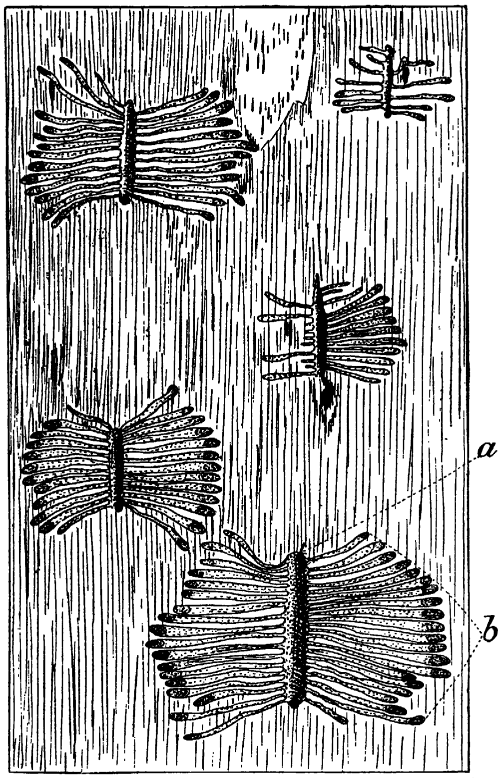


FIG. 27.—Work of the hickory bark-beetle on surface of wood beneath the bark: *a*, primary gallery; *b*, larval mines. (Original.)

EXTERNAL CHARACTER OF THE INJURY.

The first indication of attack is shown by the leaves, some of which die and remain on the twigs, while others fall early in the season. Later, in July and August, the larger branches or the entire top may

die, while the lower branches and trunk may remain in normal health. Sometimes the entire tree is killed the first season, but more often the lower portion dies from a subsequent attack. Upon examination there will be found the wounds made by the beetles at the base of the buds, which cause the leaves to die or fall. Upon removing the bark from the dead branches the characteristic brood galleries will be found in

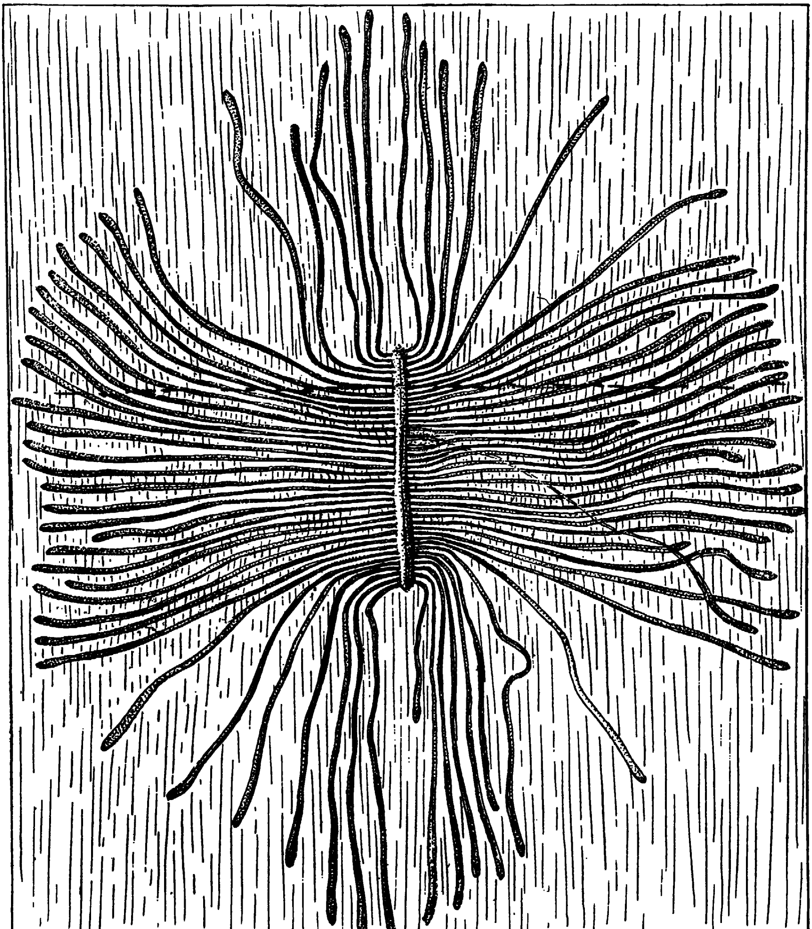


FIG. 28.—Complete brood galleries of the hickory bark-beetle in surface of wood. (Original.)

the inner bark and engraved on the surface of the wood (figs. 27 and 28). If the tree is infested the parent beetles will be found in the primary longitudinal galleries, and great numbers of small, white grubs in the larval burrows in the bark. If the broods have emerged, the bark will be found perforated with numerous small round holes, as indicated in fig. 29.

METHOD OF COMBATING THE INSECT.

The fact that there is a single generation annually, and that the generations pass the winter in the immature stage in the bark, makes it a comparatively easy pest with which to deal. It is only necessary to determine which trees are actually infested at the beginning of winter, and to see that these are cut and the bark burned before the middle of the following May. If the greater number of infested trees over a considerable area are thus treated, the number of the insects will be so reduced that they can not continue their destructive depredations on living trees. It is important to remember that there is nothing to be gained by cutting and burning the old dead trees after the insects have emerged, but that it is of the greatest importance to locate all trees which have died within a year from the 1st of June and are infested, and that these be cut and the insects destroyed before the 1st of May of the year following the death of the tree. In some cases it will be advisable, when the tops and branches only are dead and infested and the remainder of the tree is living, to cut out and burn the infested top and thus save the lower part of the tree. The broods can be destroyed without loss of the wood by utilizing it for fuel within the time specified, or, if it is desired for other purposes, the bark can be removed and burned or the logs placed in water until the insects are all dead.

FIG. 29.—Exit holes in bark of hickory tree from which broods of the hickory bark-beetle have emerged. (Original.)

The practical application of this method of cutting and burning the infested trees was made by the commissioner of parks and boulevards of Detroit, Mich., on Belle Isle Park, in May, 1903. A great many hickories on the island were infested, and all were threatened with destruction by this insect. Upon request of the commissioner, addressed to the Department of Agriculture, investigations were made by the writer, who recommended that the infested trees be cut and burned before the broods of the beetles commenced to emerge. This plan was promptly adopted, and the cutting and burning of the infested trees was so thorough that no evidence of the destructive work of the beetle on the remaining trees has since been observed.

BARK-BEETLE INJURIES TO OAK TREES.

Different kinds of oaks, of sizes ranging from a few inches in diameter to large trees, are frequently found in the woods dying or recently dead, with no evidence of external injury. If, upon removing the bark from a place on the trunk some 4 or 5 feet above the base of one of these trees, the inner surface is found to be grooved with great numbers of minute transverse burrows, similar to fig. 30, *b*, which are also faintly marked on the surface of the wood, it is the work of the oak-destroying bark-beetle (*Pityophthorus pruinosus* Eichh.).

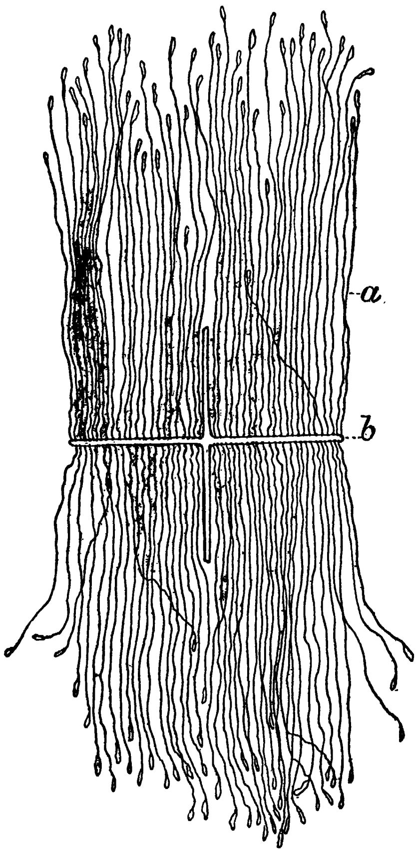


FIG. 30.—Brood galleries of the oak bark-beetle, showing character of primary gallery at *b*; larval or brood mines at *a*.

This is an exceedingly small dark-brown or nearly black beetle, less than 2 millimeters (0.08 of an inch) in length, which, notwithstanding its small size, sometimes occurs in such vast numbers that large oak trees are attacked and killed by it in a few weeks. It passes the winter in the adult and larval stage in the inner bark of trees and limbs where it bred the previous summer. It commences to fly early in the spring, and prefers to enter the bark of trees recently felled or injured by storm or other causes. It also enters the bark of large and small branches recently broken or cut from living trees. In the inner bark of these the parent adults excavate short double transverse primary galleries, from which the broods of young larvæ excavate long lateral mines (fig. 30), up and down, through the inner bark, and following the bark fibers in such a way that they are difficult to recognize. Enormous numbers of these brood galleries are often found within a small area of bark. When a large number of trees and branches are infested the swarms of beetles of the first generation will emerge later in the summer, and if they fail to find sufficient felled and injured trees in the right condition to attract them, they will concentrate their attack on a few living trees, which soon perish. The leaves of such trees will first fade, then turn brown, and remain on the branches until the next spring.

METHODS OF CONTROL.

If the trees die late in the summer the broods of the beetles will remain in the bark over winter, and can easily be destroyed by felling the trees, removing the bark from the trunks, and burning the branches. The removal of the bark in the winter is sufficient to kill the broods, but it is easier to burn the branches than to remove the bark from them. This work can be done at any time between September and the following March. If the trees die earlier in the

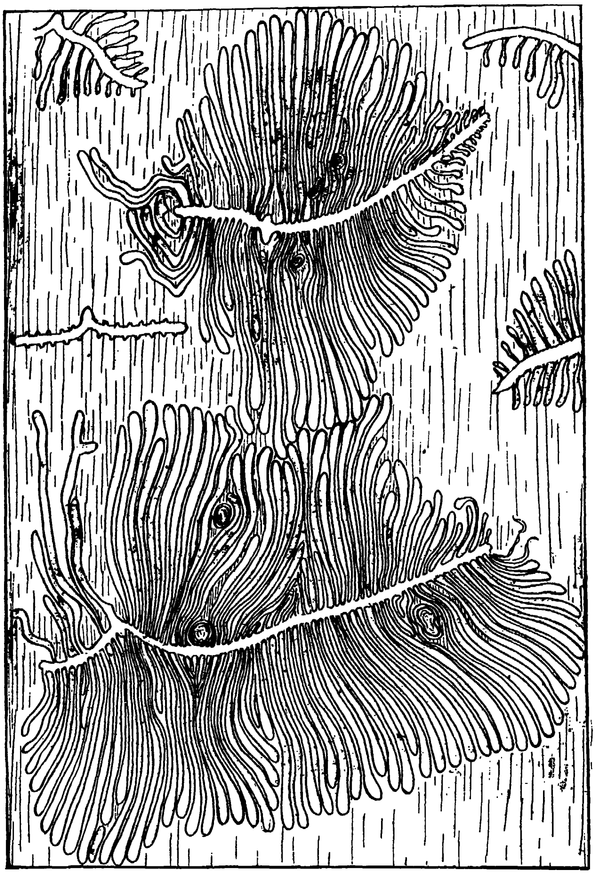


FIG. 31.—Brood galleries of the cherry bark-beetle, showing character of primary galleries and larval mines. (Original.)

season it will be best to fell them and treat as above as soon as the leaves commence to die, in order to prevent the development and emerging of a possible second generation before winter.

It is also important, especially in farmers' woodlots, to have all tops and branches from oak trees felled during the winter, piled and burned between the 1st of May and the 1st of June. This will allow the spring brood to commence operations in the bark of such material

before it is burned. All infested tops and branches of summer cuttings should be destroyed, and the bark removed from infested logs during the winter. Therefore, clean forest management and the prompt felling and removal of the bark from dying trees will serve to prevent serious harm from this insect.

Bark-beetle Injuries to Other Trees.

The wild cherry is sometimes killed or seriously injured by the cherry bark-beetle (*Phlœophthorus liminaris* Harris), but this insect rarely attacks perfectly healthy trees, although it is capable of doing so. The ornamental double transverse gallery of this beetle in the inner bark and grooves of the surface of the wood will be easily recognized by the characteristic form, as shown in fig. 31, although they are seldom found so perfect.

The paper birch and other birches of the north woods and higher Allegheny Mountains are sometimes killed by the birch bark-beetle (*Dryocœtes eichhoffi* Hopk.). Trees slightly injured by fire, which would otherwise recover, often die from the attack of this insect, yet in such trees they breed in such numbers as to attack living ones and kill them. The galleries made by this beetle and its larvæ in the inner bark (fig. 32) differ from the preceding in having no regular form, but penetrate in all directions from the main entrance and the irregular primary galleries.

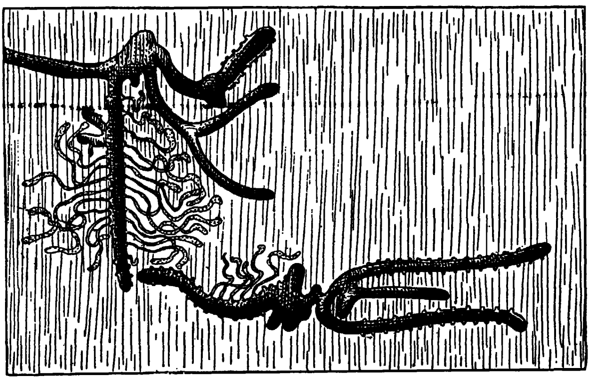


Fig. 32.—Work of the birch bark-beetle: primary galleries and larval mines in bark. (Original.)

The hackberry bark-beetle (*Scolytus muticus* Say), the elm bark-beetle (*Hylastinus rufipes* Eichh.), the mulberry bark-beetle (*Phlœophthorus frontalis* Oliv.), the ash bark-beetle (*Meliobius aculeatus* Say—fig. 33), and a number of others of this class of beetles, are sometimes quite injurious, but more often are secondary enemies which attack only injured trees and prevent their recovery.

Oaks, Chestnut, Birches, and Poplars Killed by Bark-boring Grubs.

There has been a great mortality among the oaks and chestnut of the Appalachian region which has been going on for many years. No such large bodies of timber have been killed in any one year as to attract special attention, but scattering trees all through the forest die every year. In some of the southern sections nearly all of the larger

FIG. 1.—CHARACTER OF LARVAL MINES OF OAK-DESTROYING BARK-BORER IN INNER SURFACE OF BARK.

[Original.]

FIG. 2.—LARVAL MINES OF DESTRUCTIVE BARK-BORER IN SURFACE OF WOOD OF DYING COTTONWOOD TREE.

[Original.]

chestnut trees on thousands of square miles have died, and in other sections the oaks have died to an alarming extent.

Upon investigation in different sections of the country it was found that the oak-destroying bark-borer, or two-lined chestnut borer (*Agrilus bilineatus* Web.), is directly associated with the causes of the death of the trees.

The adult of this destructive enemy of the oak and chestnut is a slender blue-black beetle with a faint yellow line along the middle of each wing cover. The larva is a long, slender, flat-headed grub, which, upon hatching from the egg deposited in the outer bark, burrows in the inner bark, through which it extends long tortuous or zigzag mines (Pl. XXXIX, fig. 1). When it occurs in numbers in a tree the inner bark is killed and the tree rapidly dies. The leaves first fade, and then dry up and remain on the twigs for some weeks or months afterwards. The insect passes the winter in the larval stage in the outer portion of the inner bark, where in the spring it transforms to the adult. The beetles commence to emerge in May and June. They deposit their eggs in the outer bark of living trees, on stumps of recently felled oak and chestnut, in trees struck by lightning or injured from other causes. They breed in great numbers in the bark of stumps and injured trees, and by this means are enabled to multiply sufficiently to attack and kill living trees.

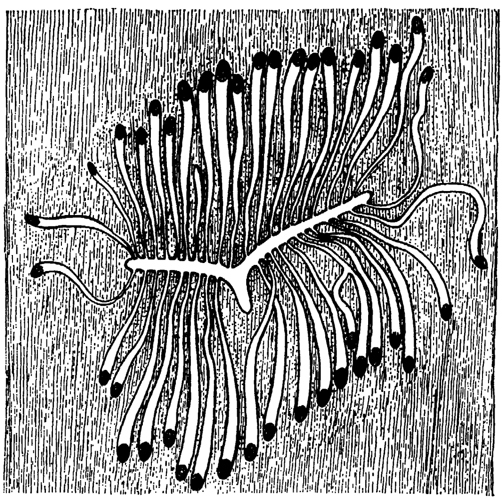


FIG. 33.—Brood galleries of the ash bark-beetle in surface of ash wood. (Original.)

METHODS OF CONTROL.

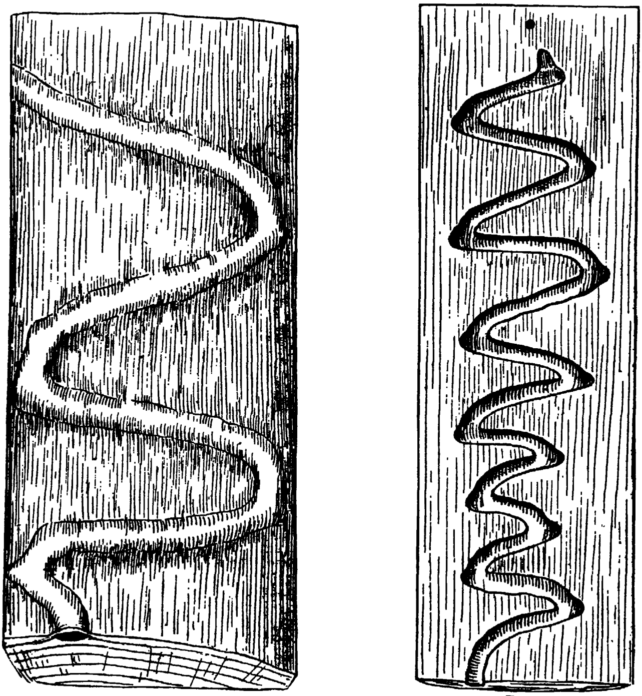
There is evidently only a single generation of this insect annually, and this fact, together with its habit of breeding in the bark of stumps and injured trees, and in those killed by it, together with its habit of transforming in the outer bark, suggests a practical method of control. All infested stumps and dying and recently dead trees should be located before the beginning of winter, or by the 1st of November, in order that the infested bark may be removed from the trunks and stumps and burned before the 1st of April.

Trees struck by lightning in May and June furnish favorable

conditions for the multiplication and destructive ravages of the two-lined chestnut borer; therefore all such trees, together with those dying from insect attack, should be felled during the summer or the winter following, and the bark removed and burned. Very often such trees can be utilized for fuel, so that nothing is lost in the operation.

The birches, aspens, cottonwoods, and balm-of-gileads are killed or seriously injured by other species of *Agrilus*, which have habits similar to those of the oak-destroying bark-borer, hence require the same treatment.

The work of these insects has been observed in the birches, aspens,



a b

FIG. 34.—Mines of a destructive bark-borer: *a*, healed-over mine in cottonwood; *b*, mine grooved in surface of wood. (Original.)

and cottonwoods from Maine to West Virginia, and westward to northern Idaho and northern New Mexico.

The curious embossed effect on the surface of the wood (fig. 34, *a*), on trees which have been infested or killed by one of these bark-borers, is the result of healed-over grooves made by the larvæ in the outer layers of wood beneath the bark (fig. 34, *b*) when the trees were living and growing. Therefore, these healed wounds furnish conclusive evidence that the trees are attacked while living. The long winding burrows beneath the bark, as shown in Pl. XXXIX, fig. 2, show how the trees are easily girdled and killed when thickly infested.

INSECT INJURIES TO THE WOOD OF LIVING TREES.

The class of injuries to the wood of living trees known as pinholes and wormholes cause an enormous loss of the best hardwood timber. Indeed the loss from this cause is perhaps far greater in the aggregate than that resulting from the work of the bark-borers already mentioned. Trees dying or dead from the work of bark-borers are conspicuous and thus attract attention, while that of the wood-borers is obscure and seldom noticed until the trees are closely examined or felled. Indeed, hundreds of generations of one of this class of enemies may breed in and emerge from a tree during its life, and the heartwood of the trunk be rendered worthless for commercial purposes, yet the tree may continue to live and grow and show little or no outward indication of damage.

PINHOLE INJURIES IN OAK WOOD.

One of the most destructive of this class of enemies of hardwood forest trees is the oak timber-worm (*Eupsalis minuta*). This is a slender whitish worm, or grub, full-grown examples of which are less than an inch long and one-sixteenth of an inch or less in diameter toward the middle of the body, while the segments toward the head are enlarged to twice this diameter. The adult is a slender reddish snout-beetle, with black markings, varying in length from 10 to 15 millimeters (0.4 to 0.6 inch). The beetles appear on the wing in April and May, and are found through the spring and summer months on or about fresh or old wounds on living trees. They deposit their eggs in the surface and edges of these wounds, and the minute young larvæ bore, at first, almost invisible holes directly into the wood. These burrows are enlarged and extended in all directions through the heartwood until the larvæ have attained their full growth. They then transform to adults within their burrows, to emerge the next spring or summer and repeat the process in the same wounds, or in the wood of dead standing trees and the stumps and logs of felled ones. Thus, an ax wound in the side of a large, sound, and healthy tree may result in an attack by this insect, and in a few years the entire heartwood of 3 or 4 feet of the trunk is perforated with the so-called pinhole defects (fig. 35). Slight wounds by lightning may, in a like manner, result in the wood of the entire trunk being thus rendered worthless for stave timber or first-class lumber.

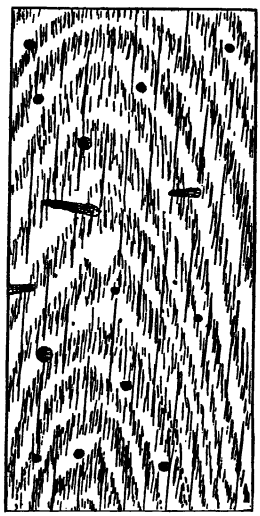


FIG. 35.—Pinholes in oak—work of the oak timber-worm. (Adapted from author's illustration.)

This insect breeds in great numbers in the trunks of old dead trees and in the stumps and logs of felled ones, and is ever ready to attack living trees wherever a slight wound in the bark offers an opportunity. It will also attack freshly split stave bolts, heavy unseasoned lumber, squared timber, and the like, and cause serious damage.

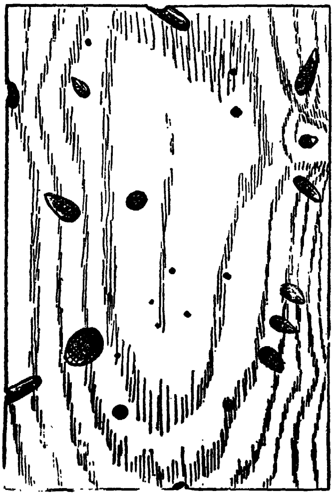


FIG. 36.—Wormholes in chestnut—work of the chestnut timber-worm. (Adapted from author's illustration.)

The losses occasioned by the oak timber-worm are enormous The finest old trees of the forest are often found by the lumbermen so injured that they are either left standing or after being felled are left in the woods. Saw logs which appear to be sound at the ends are often found so damaged in the middle that they must be discarded or worked into cheap lumber and culls. Therefore, the losses fall on the owner of the forest and the manufacturer of the crude products, while the consumer loses in the extra high prices he must pay for clear lumber. Nothing can be done toward remedying the damage already done to standing and felled timber, but the insect's habit of breeding in dead standing and felled oak trees and old logs in the forests and of entering ax and other wounds in living trees, suggests the importance of clearing out and burning all such waste material whenever practicable, and of avoiding as far as possible all unnecessary wounds to living trees. Indeed, the disposal of all prolific sources of trouble from this insect will always be an important feature in the management of American hardwood forests and farmers' woodlots.

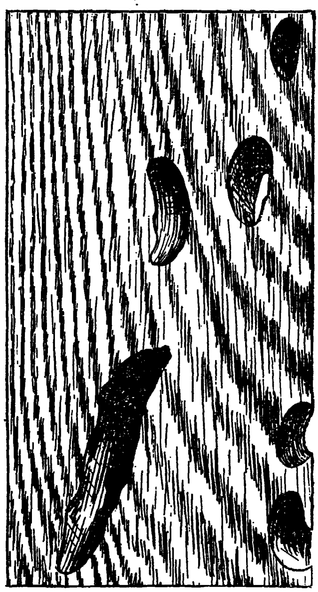


FIG. 37.—Wormholes in red oak—work of the oak carpenter-worm. (Adapted from photograph.)

PINHOLE AND WORMHOLE INJURIES TO CHESTNUT WOOD.

Wormholes in chestnut wood are such a common defect that no one who has had anything to do with this kind of wood can have failed to notice them. Indeed, scarcely a chestnut tree of any size can be found in the Eastern hardwood forests the wood of which does not show more or less injury of this kind, while that of nearly

all old trees is thickly perforated. This common defect (see fig. 36) is the work of the chestnut timber-worm (*Lymexylon sericeum* Harr.).

CHARACTERISTICS OF THE CHESTNUT TIMBER-WORM.

The chestnut timber-worm is a curious, yellowish-white, slender larva, full-grown examples of which are about an inch long. It has a hood-like enlargement just back of the head, and the opposite end of the body is armed with a horny, dark-brown, gouge-like segment, with toothed edges. The adult is a dark-brown, elongate, subcylindrical beetle, densely clothed with fine silky hairs. Individuals vary from 10 to 15 millimeters (0.4 to 0.6 inch) in length.

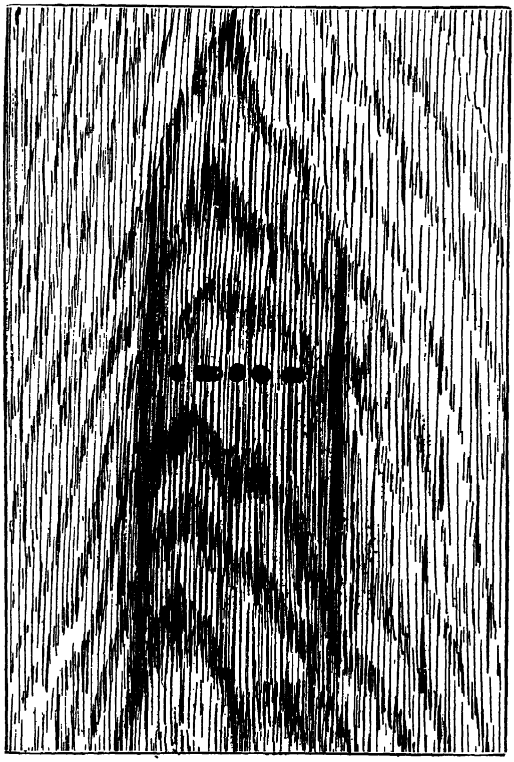


FIG. 38.—Work of the Columbian timber-beetle: Black holes and "grease spots" in white oak. (Original.)

The habits of this insect are quite similar to those of the oak timber-worm in breeding in the wood of dead and felled trees and infesting wounds in the wood of living ones. It also enters the living trees at the base of dead or broken limbs, and through small or large knot holes in the trunk. Very little is known of the life history except that the adults develop and emerge about the time the chestnut is in bloom. It is probable that the larva lives several years in its burrow before transforming to the adult, which would account in part for the scarcity of the insects in collections. The common occurrence of its work is explained by the fact that the holes in the wood of old trees may represent the work of many generations during two or three centuries.

METHODS OF PREVENTING LOSSES.

In addition to clean forest management and other methods of combating the oak timber-worm, which are just as applicable to this pest, it is important to clean out the old trees and encourage the growth of thrifty young ones, which are less liable to attack, and to cut these for poles or lumber as soon as they reach a sufficient diameter to be profitably handled.

The extensive development within recent years of the industry of manufacturing tannin extract from chestnut wood has made a market

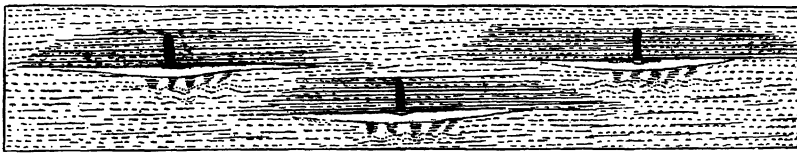


FIG. 39.—Work of the Columbian timber-beetle: "Steamboats" in quartered or split white oak. (Adapted from author's illustration.)

for a large quantity of "wormy" chestnut wood in some sections of the country. Indeed, it is said that the wood which is badly perforated with the wormholes is just as good for the purpose as the uninjured, if not better.

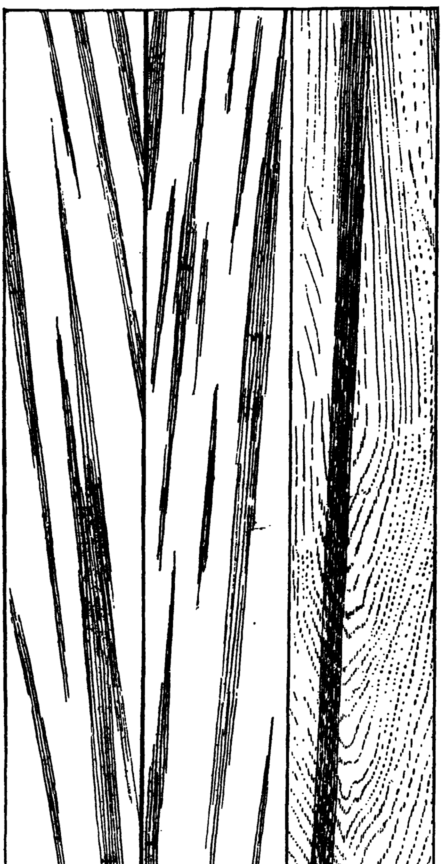


FIG. 40.—Work of the Columbian timber-beetle in tulip wood—"calico poplar." (Original from photograph.)

CARPENTER-WORM INJURIES TO OAK AND LOCUST.

The very large oblong wormholes (fig. 37) commonly met with in the heartwood of red oak and other oak trees, and also in that of the black or yellow locust, is usually the work of the so-called carpenter worm (*Prionoxystus robiniæ* Peck). The larvæ are large white and pink caterpillars which hatch from eggs deposited by stout-bodied, short-winged, gray moths. The caterpillars often attain a length of 3 inches and a diameter of over half an inch. The holes made by them through the heartwood of the best part of the trunk are sometimes 1½ inches in diameter one way by three-fourths of an inch the other, thus causing serious damage to the wood. These, with other large wood-boring grubs of beetles, sometimes infest the top part of the trunk and larger branches of oak trees, where their continued work results first in the dead and so-called "stag-horn" top, and subsequently in

broken, decayed, and worthless trunks. The great number of "stag-horn" tops of the older oak trees in our forests everywhere give evidence of the destructive work of this class of heartwood borers.

METHODS OF CONTROL.

The only method we have to suggest for combating this insect is to fell and utilize all matured timber that shows the slightest indication of diseased conditions of the top, and clean up and burn such parts as show evidence of being infested.

WORK OF THE COLUMBIAN TIMBER-BEETLE.

One of the commonest wormhole defects in white oak, rock oak, beech, and tulip ("whitewood" or "yellow poplar") is one known to the lumber trade as grease spots, patch-worm, or black holes (fig. 38), steamboats (fig. 39), etc., caused by the Columbian timber-beetle (*Corthylus columbianus* Hopk.).

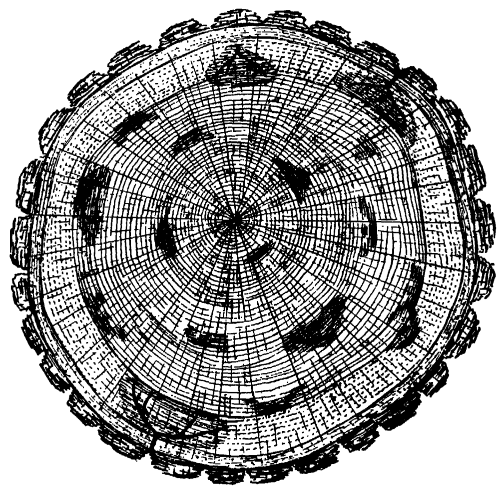


FIG. 41.—Work of Columbian timber-beetle: End of log, showing evidence of serious damage, and how the brood galleries made in the sapwood are covered by subsequent growths of wood. (Adapted from author's illustration.)

CHARACTER OF THE WORK.

The characteristic features of the wormhole defect, which will enable it to be readily recognized in oak and beech, are transverse series of two or more black holes about the size of the lead in an ordinary lead pencil, with a streak of stained wood extending with the grain 2 or 3 or more inches each side (as in fig. 38). In quarter-sawed oak or split or sawed staves, a short longitudinal section of one of these black holes is seen attended by the stained streak on one side of a thick or curly growth or grain (fig. 39). It is this form which is called steamboats. In whitewood or yellow poplar the black holes are attended by very long black, greenish, or bluish streaks, sometimes 5 or 6 feet long. When this is common in the lumber it is called calico poplar. Fig. 40 represents the characteristic appearance of this defect greatly reduced. The appearance of the defect in the end of a log is represented in fig. 41, and in the sapwood of a living tree in fig. 42.

The beetle which is responsible for this defect and the resulting losses to the lumber interests of this country, amounting to millions of dollars, attacks the sapwood of the young, living, healthy tree, in which the adults excavate their brood galleries (fig. 43) and deposit their eggs. These hatch and develop into beetles, and emerge within one year. The next year the operation is repeated in another place in the same tree, and so on for hundreds of years, or as long as the tree lives, so that the galleries excavated in different years and periods occupy their respective positions in the heartwood and sapwood of the full-grown and old tree, as shown in fig. 41.

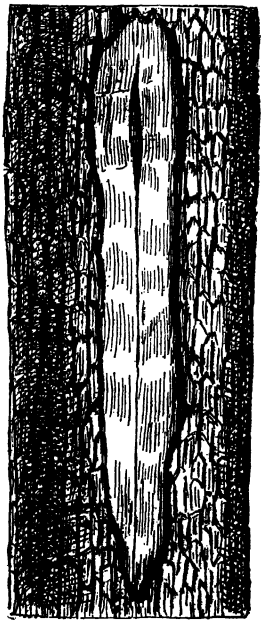


FIG. 42.—Work of Columbian timber-beetle in sapwood of living tree. (Original from photograph.)

Nearly all the damage by this insect, as affecting the best part of the trees, was done 50, 100, 200, or, in some cases, as noted in an old tulip tree, over 400 years ago. The age of each gallery observed in the end of the log is easily determined by counting the number of annual layers of wood between the old healed-over entrance to the galleries and the bark.

Within recent years, examples of the species which do this work have been exceedingly scarce; consequently but little evidence of its work can now be found in the sapwood and outer heartwood of living trees. Therefore, there is no remedy for the old work, and probably no need of trying to combat an insect which is apparently becoming extinct. The only thing to do in a case of this kind is to fell and utilize to the best advantage the injured trees, and thus give the younger uninjured trees a better opportunity for rapid growth.

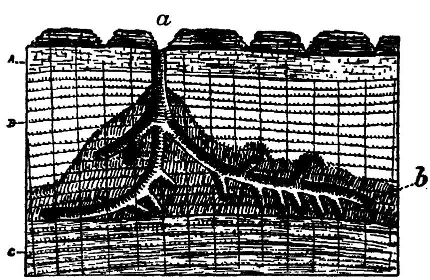


FIG. 43.—Brood gallery of Columbian timber-beetle in sapwood of white oak: *A*, inner bark; *B*, sapwood; *C*, heartwood; *a–b*, brood chamber. (Adapted from author's illustration.)

MACARONI WHEAT.

By James H. Shepard,
Chemist, South Dakota Experiment Station.

VARIETIES AND COUNTRIES OF COMMERCIAL PRODUCTION.

Macaroni wheat is known botanically as *Triticum durum*, to distinguish it from ordinary bread wheat or *Triticum vulgare*. There are many varieties of macaroni wheat. Whether these all originated from one parent stock is not known, but such a supposition is not improbable. The durum wheats are grown in widely separated localities, and it is quite probable that long cultivation under certain climatic influences has tended to emphasize such varietal distinctions as are now exhibited by these wheats.

The durum wheats are grown commercially in certain localities in Spain, Italy, Algeria, India, Russia, and Argentina; and one variety, the Wild Goose, in Canada. In the United States some varieties, such as the Wild Goose and the Arnautka, have been grown in a desultory manner for a number of years. The small amount produced was grown mostly in the Northwest, but owing to insufficient information as to its properties and uses and to a lack of a regularly established market it made little headway.

INTRODUCTION OF MACARONI WHEAT BY DEPARTMENT OF AGRICULTURE.

In 1899 the Department of Agriculture sent Mr. M. A. Carleton, the assistant in charge of cereal investigations, to Europe and to Asiatic Russia in order to gain all possible information in regard to macaroni wheat, and to select such varieties as would probably succeed in the Great Plains region, and especially in the semiarid portions, where ordinary bread wheats were sometimes at best but an indifferent crop. Mr. Carleton made a very thorough exploration and secured a large number of varieties of the durum wheats, many of them being in small quantities only, for scientific investigations. But from the Russian provinces north of the Sea of Azov, the home of the best of the macaroni wheats, where the climatic conditions bear a striking resemblance to those of the Great Plains, he secured a number of bushels of the best varieties, such as the Kubanka, the Velvet Don, and the Yellow Gharnovka. These wheats the Department of Agriculture

distributed to growers in suitable localities, thereby increasing the stock. It was the privilege of the writer to assist in propagating some of these varieties, thus affording him an opportunity to make an early acquaintance with them under field conditions. The crop secured, together with two fresh importations, was distributed in 1901 to the farmers of the Northwest through the experiment stations of the various States. In the spring of 1900 the Northwestern State experiment stations, in cooperation with the Department of Agriculture, undertook the exhaustive study of the new wheats. In this work the South Dakota station has taken an active part, and the writer has had occasion to make a critical study of the chemical and milling properties of the different varieties.

INCREASE IN THE PRODUCTION OF MACARONI WHEAT.

Since the Department of Agriculture undertook the work the production of macaroni wheat in the Northwest has increased with astonishing rapidity. The estimated crop of the two Dakotas alone during the season of 1903 is 10,500,000 bushels. Perhaps no other new crop has been so warmly welcomed by farmers in the regions suitable to its growth. The reason for this is found in the splendid adaptability of these new wheats to the climatic and soil conditions of the Great Plains region. Macaroni wheat thrives in abundant sunshine, does not require a large amount of moisture, resists vigorously the attacks of the smuts and rusts, and is a strong grower, yielding largely (from 25 to 100 per cent) in excess of the ordinary bread wheats, which often produce indifferent crops in the semiarid regions of the Northwest.

The several varieties of macaroni wheat, while differing widely in their chemical and milling properties, nevertheless possess many traits in common. They have strong straws, which prevent lodging; also heavy and somewhat persistent chaff, furnished with long beards, which protect the kernels from the fierce heat of the sun and prevent shattering—a grave objection to our common blue-stems.

METHODS OF CULTIVATION.

The cultivation of these new wheats requires little variation from the methods employed in growing ordinary spring bread wheats. The same soils answer admirably; sowings are made at the same time in the spring, and the preparation of the soil is the same. It is probable that some varieties can be converted into winter wheats farther south. Owing to the large kernels of the macaroni wheats, and to the fact that they do not stool so freely, 5 pecks per acre are sown on good rich soil, while a poorer soil requires at least 6 pecks. Before harvesting, the grain is allowed to ripen fully, and if it can be

thrashed without suffering from rains the quality of the grain is much improved. It is better, therefore, to thrash directly from the shock, when possible. When the wheat is first stacked, before thrashing, it should be allowed to go through the usual sweating process and become thoroughly dry, otherwise it will offer some difficulty in thrashing. In any event, the thrasher must have a full set of concave teeth, and the sieves must be so arranged that broken heads and white caps are faithfully returned to the cylinder for a second beating; otherwise much grain will be lost in the straw.

CLASSES OF MACARONI WHEAT.

It has been found convenient while investigating the different varieties of macaroni wheat to divide them into three classes: First, the Northern or Russian varieties; second, the Southern or Mediterranean; and, third, the miscellaneous varieties, which have come from more widely separated localities. In some respects all the durum wheats have properties in common. The kernels are somewhat larger than those of the common wheats, but as compared with one another a considerable variation in size and color is plainly observable. All the durums have an extremely hard kernel of a flinty or horny texture, sometimes appearing as if faintly translucent. In color the different varieties vary from a comparatively dark shade to a light yellow. But, in regard to both hardness and color, the different varieties show marked variations among themselves. As a rule, the Russian sorts are harder and more nearly translucent. Both the Velvet Don and the Black Don have dark-colored kernels, while the Kubanka and the Gharnovkas have a lighter color. The Yellow Gharnovka is of a yellowish tinge, as its name indicates. The chaff and beards of most of the macaroni wheats are white, but in the Black Don both are black, while the Velvet Don has white chaff and black beards.

THE PROTEIN CONTENT OF MACARONI WHEAT.

One of the first questions to arise in introducing the new wheat is, Can a variety or varieties of macaroni wheat be found that will preserve all essential characteristics in their new home? It must be remembered that it is a violent change of habitat to carry seed grown in the Azov districts of Russia half way round the globe and sow it at some point in the Great Plains extending from North Dakota to Texas.

The peculiar property of macaroni wheat which makes it valuable for its distinctive uses is its protein or gluten content. If, then, these new wheats can be grown in the semiarid region for a series of years without suffering a diminution of protein, it is safe to infer that the transplantation may be successfully made. Accordingly, one of the first determinations made each year is the protein factor. The Kubanka

variety from the Uralsk territory is one of the very best for the semiarid districts, and its behavior will throw much light on this question. The original seed, as imported, gave 14.1 per cent protein. When grown in South Dakota the next year, 1901, it gave 18.8 per cent protein. This South Dakota seed, sown in 1902, a wet, unfavorable year, gave 13.9 per cent crude protein, or practically the same as the imported seed. If this series continues at the same rate, the Kubanka variety promises to improve rather than to deteriorate in its new habitat. An extended investigation with other varieties also tends to show that many of the durum wheats will maintain their protein content successfully on the Great Plains of the Northwest. But the protein content will vary in any variety from year to year. In dry, favorable seasons the protein will run high and in wet years it will run low. This is also true of all the essentials, as plainly shown in the last two lines of the table following:

Chemical and milling factors for macaroni wheats.

[Factors calculated to an air-dry basis.]

Number of analyses made.	Name or variety of sample.	Mill products.				Crude (N. × 5.7) protein.			
		Bran.	Shorts.	Flour.	Error.	Wheat.	Bran.	Shorts.	Flour.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
11	Kubanka	19.17	13.04	67.73	−0.06	13.71	13.90	13.69	13.53
12	Gharnovka	28.12	14.08	57.88	+0.08	14.33	14.49	13.99	14.29
3	Arnautka	16.49	13.20	70.39	+0.08	14.79	15.05	14.45	14.71
5	Pellissier	34.29	15.84	49.61	−0.26	14.78	15.01	14.09	14.34
1	Saragolla	21.98	14.10	63.32	−0.60	12.01	12.91	12.23	11.63
3	Argentine	25.31	13.03	60.65	−1.01	14.50	15.42	14.28	13.96
1	Walnak	30.38	14.04	56.34	+0.76	13.43	13.96	12.61	12.76
1	Kubanka, maximum	6.38	20.83	71.54	−1.25	16.63	16.25	17.39	16.94
1	Kubanka, minimum	23.84	26.30	50.70	+0.84	11.62	11.47	11.55	11.02

Number of analyses made.	Name or variety of sample.	Distribution of crude protein in wheat.								
		Protein in 100 pounds wheat and in mill products therefrom.					Distribution between mill products of total protein in wheat.			
		Whole wheat.	Bran.	Shorts.	Flour.	Error.	Bran.	Shorts.	Flour.	Error.
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pound.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
11	Kubanka	13.71	2.62	1.79	9.23	−0.07	19.48	13.26	66.93	−0.33
12	Gharnovka	14.33	4.13	1.68	8.26	−0.26	27.97	13.55	56.76	−1.72
3	Arnautka	14.79	2.43	1.94	10.33	−0.09	16.75	12.90	70.05	−0.30
5	Pellissier	14.78	5.09	2.24	7.16	−0.29	34.69	15.11	48.15	−2.05
1	Saragolla	12.01	2.84	1.73	7.36	−0.08	23.65	14.40	61.28	−0.67
3	Argentine	14.50	3.91	1.88	8.42	−0.29	26.86	12.82	58.18	−2.14
1	Walnak	13.43	4.24	1.77	7.19	−0.23	31.57	13.18	53.54	−1.71
1	Kubanka, maximum	16.63	1.04	3.62	12.12	+0.15	6.25	21.77	72.88	+0.90
1	Kubanka, minimum	11.62	2.74	3.04	5.59	−0.25	23.58	26.16	48.11	−2.15

Chemical and milling factors for macaroni wheats—Continued.

Number of analyses made.	Name or variety of sample.	Gluten in flour. Wet gluten	Dry gluten	Water capacity. Water held by 1 gm. dry gluten	Number of analyses made.	Name or variety of sample.	Gluten in flour. Wet gluten	Dry gluten	Water capacity. Water held by 1 gm. dry gluten
		Per ct.	*Per ct.*	*Grams*			*Per ct.*	*Per ct.*	*Grams.*
11	Kubanka	44.66	15.35	1.95	1	Walnak	42.97	14.72	1.92
12	Gharnovka	48.99	16.95	1.89	1	Kubanka, maximum	54.83	18.03	2.04
3	Arnautka	45.35	16.33	1.76	1	Kubanka, minimum	34.65	12.25	1.83
5	Pellissier	47.03	16.31	1.91					
1	Saragolla	39.22	12.94	2.03					
3	Argentine	51.26	17.10	1.97					

The maximum Kubanka is a Dakota-grown sample on high land in the favorable year 1901. The minimum is the same wheat, badly shrunken, grown on rather low land in the wet year of 1902. It will be seen how great was the deterioration in every respect by comparing the two.

The data given in the table are taken from a large mass of similar determinations in the regular investigation of the new wheats under trial. The Kubanka, Gharnovka, and Arnautka are the best of the Russian varieties. The samples were grown at or near the South Dakota station, and also at Mellette, S. Dak., in the James River Valley. Two imported samples are included. Of these three varieties, the Kubanka is probably the best. The 11 analyses embrace good and poor samples alike. It can be readily seen how two or three samples like the minimum will lower the average. The Gharnovka samples were more fortunate, since no remarkably poor ones found their way into the laboratory. This variety may not maintain so high an average. The same remarks apply to the Arnautka. The Pellissier is the best of the Mediterranean wheats from a carefully selected seed. The Saragolla is the best of the Italian varieties, and the analyses were made on the imported seed. The Argentine wheats came from Argentina, and the Walnak came from India, the samples being grown in South Dakota. These results have been brought together for comparison, and they teach many interesting and valuable lessons.

When a new wheat reaches the miller he has some questions to ask: How much flour will it yield? How much feed stuff? What are their values? And when the flour reaches the baker he asks: How much wet and dry gluten does it contain? What is the water-holding capacity? It must be remembered that a high gluten content in the whole wheat does not insure the presence of a high amount in the flour. The protein may be located in the bran or shorts, the outer

covering of the grains. The data given in the table show that the protein is well distributed in the macaroni wheats. They also show that the percentage of flour is especially high in the Russian varieties, as grown in South Dakota. The table shows that the other varieties grown at the same points are thick skinned, yielding a large proportion of bran and shorts of high feeding value. This may indicate an extended use of these wheats for stock feeding, especially where moisture is fairly abundant. The table also shows a large percentage of wet and dry gluten of high water-holding capacity in the Dakota-grown samples, and that for milling and manufacturing purposes the Russian varieties are preferable for the Great Plains region, or at least for the northern portion. While the Mediterranean wheats yield a smaller percentage of flour, the flour itself is high in protein. The Saragolla, imported, and the Dakota-grown Walnak are low in protein, but the protein has a high water-holding capacity.

In our experiments in manufacturing macaroni there appears to be an indefinable quality in the different samples of flour which determines the texture, quality, and flavor of the product. It is a well-known fact that the Saragolla is the most esteemed of the Italian wheats used in the manufacture of macaroni, owing to the excellent flavor of the finished product. The work indicates that the Kubanka possesses this quality to the highest extent when grown in this country. We have not had sufficient Saragolla wheat to give this a practical test.

SUGGESTIONS FROM THE INVESTIGATIONS.

A practical lesson should be drawn from the work already accomplished. Farmers should grow only the very best of these foreign wheats. The poor and medium ones offer no advantages. We are at the very beginning of a new industry, and it is important that we start right. Another warning also should be given at this stage: When pure seed of the best variety has been obtained the utmost care should be taken to keep it pure and free from bread wheats. Any admixture will lower the value of the products, and consequently lower the price of the grain.

In making the milling tests the wheat was reduced to the grade known as "straight flour," since this product gives the total yield of flour. No difficulty will be experienced in making a macaroni "patent" flour. But in adapting a modern roller mill to the reduction of macaroni wheat some changes in the bolting arrangements will be necessary. At the present time there are about twenty-five mills in this country equipped to grind these new wheats—a very creditable showing, considering the infancy of the industry.

In the manufacture of the best grade of macaroni and other edible pastes flour is not used. A coarse, granular product known as "semolina," which corresponds to the "middlings" obtained in one

stage of grinding bread wheats, is employed. In making semolina only corrugated rolls are used, and special purifying machinery is required. One mill, in Cincinnati, is now producing a superior grade of semolina.

USES OF MACARONI WHEAT.

Macaroni wheat has many uses which will render it acceptable and valuable in American dietaries. In fact, it is deserving of a much more extended use than it enjoys at the present time; and no doubt when the manufactured products are to be had fresh and at a reasonable cost their consumption will increase enormously.

The first and most obvious use of macaroni wheat is in the manufacture of macaroni, vermicelli, and other forms of edible pastes. At the present time this country is importing these products largely. In 1903 these imports amounted to 28,787,821 pounds, valued at $1,171,922. Three years ago not a single factory in the United States was making macaroni from macaroni wheat. All that was made in this country was of an inferior quality and was sold as such on the market, being produced from bread wheats. Now several factories are using American macaroni wheat, and some are proudly branding their products "The best in the world," "Made in America from American-grown wheats," etc. It is safe to predict that in a short time all our factories will be using American macaroni wheat.

A second use for macaroni flour is for the purpose of "blending." This high-grade flour mixed with a low-grade bread-wheat flour makes a most valuable article for bread making and pastry cooking. In southern Europe blended flour is largely used, and no doubt its use in the United States will increase as the supply becomes abundant and its value better understood.

A third use of macaroni flour is for bread making. Many tests have now been made by the Dakota stations and by private families, where the flour is accessible, in addition to the tests made by the Department of Agriculture. The testimony all points in one direction, namely, that bread made from macaroni flour is very palatable and nutritious. In fact, many prefer it to ordinary wheat bread. But the use of the flour extends to many other articles of common diet, such as rolls, bread sticks, griddle cakes, grits, etc.; and there is no reason why a breakfast food far excelling a majority of those in common use at present, in both palatability and nutritiveness, can not be prepared.

A fourth use for macaroni wheat and its products is in stock feeding. Owing to the fact that it is a surer crop than bread wheat, with a heavy yield, farmers will learn to turn to this abundant source of protein in compounding balanced rations. At times, when the price of bread wheat has been low enough to warrant, stock has been fed on it at a profit. The South Dakota station has made feeding experiments

on lambs with macaroni wheat fed whole. The results obtained warrant the conclusion that this new wheat is equal to bread wheat, pound for pound. But the 1902 crop of macaroni wheat was of inferior quality, owing to excessive moisture; therefore better results may be confidently expected with a normal crop.

Finally, macaroni wheat can be exported. The foreign demand is constantly increasing and will afford an outlet for any surplus production.

CONCLUSION.

With so many splendid possibilities in its favor, macaroni wheat certainly has a great future. Its products will be a welcome addition to the tables of the whole American people; and its introduction into the Great Plains region will prove an inestimable boon to the farmers of the semiarid belt extending from North Dakota to Texas. It may take a little time and some education of both producers and consumers to secure the fullest results, but the undeniable excellence and the intrinsic value of macaroni wheat and its products will give it high rank among standard farm crops.

CULTIVATION OF DRUG PLANTS IN THE UNITED STATES.

By Rodney H. True,

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INTRODUCTION.

The demand of the United States for medicinal substances of plant origin includes at the present time products drawn from widely separated parts of the earth. In common with other lands, however, this country relies upon native plants for a great part of its materia medica, though these native resources are supplemented by those of other countries as the needs of the physician and the pharmacist may require. Since both foreign and domestic articles represent interests of great importance to the health of the people, any discussion of drug-plant cultivation must concern itself with both classes of products.

Many plants now growing in this country either as weeds or in an otherwise uncultivated state are made use of in large quantities, and in some instances have become subjects of foreign demand, being exported in larger or smaller amounts. This steady call has gradually increased until the number of tons of crude drugs gathered in the different parts of the country is enormous. In 1894 Simpson estimated that from North Carolina alone several million pounds of crude drugs were annually shipped to market. In that section of the country there is, as a result, a great diminution in the quantity of the higher-priced products collected. Indeed, it is safe to say that in some cases plants which were formerly abundant and apparently exhaustless in quantity are now scarcely to be found at all. The difficulty here noted is one which has been greatly increased by the cutting of the forests, thereby removing the conditions necessary to the growth of large parts of the flora of the region. In other cases the use of lands for pasturage has caused the extermination of certain of the plants in question. The bringing of ever-increasing areas under the plow is another efficient cause of decrease in the production of wild drug plants.

Thus the stock of native drug products has tended from year to year to decrease, with the further result that prices paid to collectors have steadily risen. This increased value of the roots, leaves, barks, and other products sought has stimulated the gatherer to greater thoroughness in ransacking the fields and forests. A shortage has already

become keenly felt in the case of golden seal (*Hydrastis canadensis* L.), seneca snakeroot (*Polygala senega* L.), and a number of other now relatively rare drug plants, and this shortage is certain to continue with increasing demand and to affect a larger number of products until the last available wild stock is in the drug dealer's hands.

There is but one remedy for this situation. The rare native drug plants must be brought under cultivation or they will cease to exist in commercial quantities. In a number of instances the necessity for cultivation seems to be near at hand. The case of golden seal may be regarded as typical of others at present less acute.

Golden seal, once very abundant in woodlands throughout the Ohio Valley and eastward, has become increasingly difficult to obtain in commercial quantities. As a result of this shortage and of manipulations of prices made possible by this shortage, its value has risen to about 75 cents per pound in the wholesale market, and the drug is difficult to obtain even at that price. This seems to make the growing of golden seal worthy of trial as a possible agricultural resource of limited scope. The production of excessive quantities would, of course, result in a depression of prices. In 1884 Lloyd [a] estimated that the average annual production in the United States was about 150,000 pounds. Later statistics are not at hand.

Golden seal should be grown in rich, loose garden soil made to resemble as closely as possible that seen in deciduous forests. An abundance of decayed vegetable matter will do much to aid growth. The plants should be obtained from the woods and transplanted in rows about 1 foot apart, 6 inches from each other in the row. Transplantation can most successfully be made in the late summer after the leaves have dried and the plant is ready for the winter rest period. If not done then it should be done as early as possible in the spring, care being taken that the new shoots or buds are not injured. Rhizomes thus transplanted will send out leaves and flowers in the early spring. The rhizomes grow quite rapidly, and by branching and budding make it easy after a couple of seasons to multiply the stock considerably by cutting up the rhizomes in the fall into pieces, each one of which bears a bud, and planting them. In an experimental patch grown on the Potomac Flats at Washington the increase in the number of plants following such a method of division after growth for two seasons was about four times the original number. It is probable that roots obtained by division will, when allowed to grow, reach a size suitable for harvesting and drying in about three years. The general regions that seem most likely to be adapted to the cultivation of golden seal are those in which it has developed best in nature. These embrace an area including the Ohio Valley and the Appalachian Mountains southward to Georgia.

[a] Lloyd, J. U. & C. G. Drugs and Medicines of North America, Vol. I, p. 94.

The cultivation of seneca snakeroot (*Polygala senega* L.), cascara sagrada (*Rhamnus purshiana* DC.), and the coneflower (*Echinacea angustifolia* DC.) is being made the subject of experiment in connection with the investigations of the Department of Agriculture on drug cultivation. As yet, however, the information at hand is insufficient to justify recommendations concerning the best methods of cultivation.

IMPORTATION OF DRUG-PRODUCING PLANTS.

To anyone inspecting carefully the customs reports of the Treasury Department, so far as they concern the trade in drugs and medicinal substances, several striking facts appear. At the present time the United States is importing many products derived from plants already well established in this country, and occurring in some cases even as noxious weeds. Burdock, curly dock, dandelion, and couch grass, plants included in the list of weeds under the ban of the law in many States, furnish crude drugs now imported in considerable quantities. Other products are furnished by plants grown at present for other purposes. Corn silk, many tons of which are annually now bought abroad, is an example.

The total crude-drug importation into the United States for the fiscal year ended June 30, 1902, was valued at about $15,000,000. Of this sum, perhaps two-thirds was paid for products grown in parts of the world which differ so widely from the United States in soil and climate that there is little probability, all other conditions being favorable, that they could be produced on this continent. Of course the proportion of products not suited to our conditions, were account taken of the agricultural resources of the tropical and subtropical islands now under the American flag, would be very much smaller.

In the following table the crude drug importation of 1902 is summarized, including only items equaling or exceeding $25,000.

Summary of crude drug importations for the fiscal year ended June 30, 1902.

Articles.	Quantity.	Value.
BARKS.		
Cinchona ....pounds..	3,660,718.00	$617,716.00
All other barks		20,729.00
Total		638,445.00
ROOTS.		
Gentian ....pounds..	969,783.00	28,119.00
Orris ....do....	535,953.00	25,930.00
Licorice ....do....	109,083,568.00	1,927,140.00
Ipecac ....do....	42,150.00	68,599.00
Ginger ....do....	3,686,438.00	223,417.00
Sarsaparilla ....do....	1,003,673.00	77,617.00
All other roots		142,434.60
Total		2,493,286.60

Summary of crude drug importations for the fiscal year ended June 30, 1902—Continued.

Articles.		Quantity.	Value.
LEAVES AND FLOWERS.			
Buchu leaves			$29,336.00
Chamomile flowers			46,151.00
Senna leaves			90,848.00
Saffron, safflower, etc			35,005.13
Other leaves and flowers			2,717.00
Total			204,057.13
SEEDS AND FRUITS.			
Cubebs	pounds	312,550.00	25,317.00
Tonka beans			114,251.00
Vanilla beans	pounds	359,834.35	861,270.00
Caraway seeds	do	2,296,335.25	110,511.04
Cardamom seeds	do	68,765.00	32,918.00
Castor bean seeds	bushels	312,323.00	356,901.00
Cumin and fenugreek seeds	pounds	991,178.00	27,024.71
Mustard seeds	do	2,279,047.00	77,504.00
Poppy seeds	bushels	32,402.00	68,991.00
Other seeds and fruits			60,582.37
Total			1,735,270.12
FATTY OILS.			
Sesame oil	pounds	707,760.00	57,359.00
Cocoa butter	do	3,548,041.70	782,815.00
Other fatty oils			3,231.00
Total			843,405.00
VOLATILE OILS.			
Anise oil	pounds	79,810.00	93,520.00
Bergamot oil	do	99,886.00	166,651.00
Cassia and cinnamon oils	do	83,558.75	49,436.00
Citronella oil	do	643,033.00	118,430.00
Lavender and aspic oil	do	124,075.00	114,691.00
Lemon oil	do	391,485.50	282,092.00
Orange flowers oil	do	7,761.00	64,963.00
Orange oil	do	79,160.50	104,159.00
Attar of roses	do	58,759.50	257,530.00
Thyme oil	do	40,080.00	25,944.00
All other volatile oils			370,532.35
Total			1,647,948.35
BALSAMS, GUMS, AND RESINS.			
Arabic	pounds	4,258,228.00	340,487.00
Asafetida	do	216,229.00	29,683.00
Camphor (crude)	do	1,831,058.00	576,405.00
Senegal	do	410,133.00	43,850.00
Tragacanth	do	1,095,870.00	341,048.00
Opium (crude)	do	548,673.50	1,262,369.00
Copaiba balsam	do	235,194.00	62,785.00
All other balsams, gums, and resins			231,198.00
Total			2,887,825.00

Summary of crude drug importations for the fiscal year ended June 30, 1902—Continued.

Articles.	Quantity.	Value.
SPICES USED AS DRUGS.		
Cassia and cassia buds ....pounds..	4,209,137.00	$393,148.00
Cinnamon and chips ....do....	358,831.60	55,512.00
Cloves ....do....	1,946,897.00	155,658.40
Ginger root (not candied) ....do....	3,686,438.00	223,417.00
Mace ....do....	466,864.00	84,913.00
Nutmegs ....do....	1,868,619.00	343,603.00
Pepper, black and white ....do....	16,272,292.00	1,783,515.00
Pimento ....do....	4,025,545.00	190,812.00
Capsicum, red pepper ....do....	2,598,386.20	162,046.44
Total	....	3,392,624.84
MISCELLANEOUS CRUDE DRUGS.		
Kelp, sea moss, etc	....	38,242.23
Nutgalls	....	124,867.00
Ergot ....pounds..	177,145.00	67,548.00
Other miscellaneous crude drugs	....	25,364.00
Total	....	256,021.23
Crude drugs of all classes not listed above	....	447,201.18
Total value crude drug substances	....	14,546,084.45

It should be noted that the above table indicates the magnitude of the demand of a year for crude substances which have not been advanced in price by preparation. In many cases the article is treated abroad in such a manner as to concentrate the valuable principles found in the crude drug, reducing, among other expenses, the cost of transportation. In those cases the above exhibit fails to show this additional demand for the necessary crude material. This is illustrated by coca leaves, which are imported both as such and also in effect in the alkaloid cocaine derived from them.

The following table shows the amounts of importations for the fiscal year ended June 30, 1902, of articles of a medicinal character which have been advanced in value by refining, grinding, or other treatment:

Drug substances of vegetable origin, advanced in value by preparation, imported during the fiscal year ended June 30, 1902.

Articles.	Quantity.	Value.	Articles.	Quantity.	Value.
Caffeine ....pounds..	16,437	$40,858.00	Salacin ....pounds..	4,938	$17,432.00
Camphor (refined)..do....	186,881	61,591.75	Santonin and salts..do....	1,980	7,152.00
Cinchona alkaloids (quinine, etc.) ......ounces..	3,005,894	848,316.00	Strychnin and salts..ozs..	687	296.50
Cocaine	....	254,201.00	All other drugs advanced in value by refining, etc	....	87,098.72
Licorice paste, etc....lbs..	651,314	81,533.00	Total	....	1,495,733.97
Morphine salts ...ounces..	38,002	96,559.00			
Opium extracts, tinctures, etc	....	696.00			

The market afforded by the United States during the year 1902 for products derived from drug-producing plants is represented by the sum of the totals of the two classes mentioned—a grand total of $16,041,818.42.

PROSPECTS FOR GROWING DRUG PLANTS.

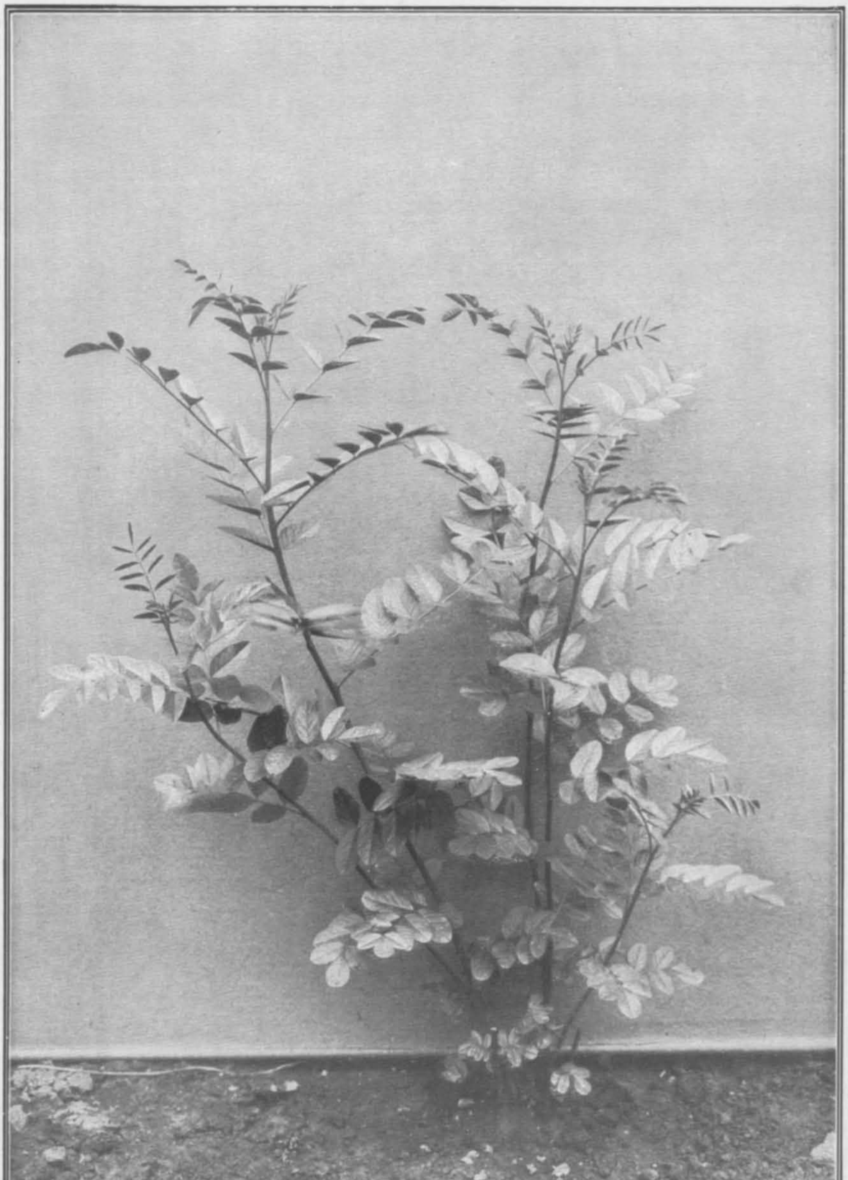
Even if it be assumed that this country has the conditions of soil and climate necessary for the growing of any of these products, it is by no means determined that a profitable industry will follow. In foreign countries the products concerned are frequently derived from wild plants growing in unused land and the collecting is done by laborers who work for a few cents a day. Therefore, it is possible that with the necessary transportation charges to our market added to the cost of production the total cost of the drugs delivered in this country is not sufficient to give them a selling price with which American farmers can profitably compete. If home production is to succeed, the greater efficiency of American labor must be combined with improved methods. The use of machinery must replace hand work when possible. Since the expense of cultivation and handling diminishes proportionally as the production is increased, the scale of operations will need to be as large as the market demands will permit. This factor alone will exert a very great influence, since, with the danger of overproduction imminent, the prospective drug grower must be cautious.

It may fairly be assumed that in the United States may be found the soil and climatic conditions fitted for growing plants that will furnish from one-fourth to one-third of the products above mentioned, such articles aggregating a value of from $4,000,000 to $5,000,000 per annum. When the insular possessions are included, it seems probable that but a very small part of the demand is satisfied from plants that could not be grown under soil and climatic conditions found in some part of the territory of the United States. This, however, is far from saying that their culture could be carried on with profit.

Confining the discussion to the United States proper, some of the conditions facing the prospective drug farmer may be noted.

In general, it is probable that in few cases, where soil and climatic conditions are acceptable, will it pay to attempt the cultivation of drugs on high-priced lands. It is probable that the shipment of products for reasonable distances will be preferable to locating near the larger cities furnishing the market. The happy mean can not be determined without experiment, and will probably differ for each market.

Another very important factor is the price of labor. In many of the processes connected with drug-plant culture much hand work is



LICORICE PLANT.

[Grown by H. N. Rittenhouse, Philadelphia. Photographed by Daniel S. Rittenhouse.]

unavoidable. In picking leaves, seeds, and fruits, in digging certain types of roots and preparing them for market, and in grading and sorting the products hand work is necessary.

The growing of drug plants, if resorted to in the United States to a degree enabling this country to supply its own demand, will presuppose the employment of considerable areas of our most fertile soil located within reach of lines of transportation. This class of land is probably already largely used in growing other crops. If this new line of work is to secure a place in American agriculture, it must show that it can yield returns equal to or greater than the crops now occupying the attention of the farmer. This must be determined by actual experiment on a commercial scale.

The best methods of procedure must also be learned by experiment, largely in the light of experience already gained in foreign countries. Every possible labor-saving device or apparatus for performing work by machinery instead of by hand must be made use of if this line of agriculture is to establish itself in the United States.

As a result of such a study of the situation as has thus far been practicable, the Southern States seem to offer many advantages for the prospective drug grower. The long growing season needed for many drug plants, the low price of labor, and the usual low price of land combine to make sections of the South seem promising in this connection.

EXPERIMENTS OF THE DEPARTMENT OF AGRICULTURE.

Thus far the experiments of the Department in drug-plant cultivation have been confined to small areas, and no trials on a true commercial scale have been possible. It is therefore not yet practicable to make definite recommendations based on our own experience to those desiring to cultivate drugs. Judging by the data at hand, however, certain plants may be singled out as being more or less promising. A brief discussion of some of these will indicate typical requirements, so far as now determined. Only those products are here discussed for which there is a considerable demand, as indicated by the amounts of importation or by other data. This, therefore, includes products which are not liable to immediate overproduction, which danger could further be guarded against by growing a variety of products.

LICORICE.

The supply of licorice at the present time is chiefly derived from lands bordering on the Mediterranean, where the plant grows wild and where its collectors constitute a very cheap class of labor. The demand of this country for licorice products, as given in the tables for the year 1902, amounted to $1,938,315.

The licorice plant (Pl. XL) is a perennial, having an extensive system of rather fleshy, juicy roots, which penetrate the soil to

considerable depths. It may be propagated from root cuttings, some time being gained by this method over that of growing from the seed. This plant does best in a deep, rich, well-drained soil. In England, where licorice culture is carried on to a considerable extent in connection with market gardening, the plant requires about three or four years to mature. It is grown in rows sufficiently far apart to allow the planting of cabbages or potatoes between the rows. Thus the licorice plant has sole possession of the ground for but one or two seasons.

When mature, the roots are dug by hand, the great depth to which they penetrate making this necessary. The fresh root may be dried for shipment, if desirable, the shrinkage due to drying being about 50 per cent. The more acceptable method is to express the juice and make the extract, which can be more economically shipped.

In the face of the conditions of licorice growing in those Oriental lands at present supplying this country, all practicable measures for reducing expenses must be taken. The warmer climate and cheaper labor of the South single out this general region as most favorable for experiments of this nature.

Much valuable work on the subject of licorice in America has been done by Mr. Henry W. Rittenhouse, of Philadelphia.

CAPSICUM.

The present source of the capsicum or red pepper of the market is in the warmer parts of the Orient. Experiments made on the Potomac Flats, near Washington, and at Pierce, Tex., during the past season, indicate that both the small species used by the pharmacist (*Capsicum fastigiatum* Blume.) and the form now imported from Hungary and elsewhere, known as paprika pepper, can be made to grow and fruit abundantly in this country. The plants are grown from seed, handled like ordinary garden peppers, and the fruits on reaching maturity are hand picked. Since the plants bear flowers and ripe fruit at the same time, the product needs to be picked several times. The small size of the fruit increases very materially the labor in this regard. At Washington the shortness of the warm season prevents the ripening of much of the crop. This fact, together with the labor aspect of the case, points to the South as the most promising part of the country in which to attempt cultivation on a commercial scale. (Pl. XLI.)

OPIUM POPPY.

The importations in crude opium, in the alkaloids derived from opium and in poppy seed and the oil expressed from it, during the year 1902 were $1,431,119, not including opium prepared for smoking purposes to the value of $1,190,493.20. The present supply of opium is derived from various Oriental lands having a warm, dry climate, Asia Minor and India being important regions of production.

FIG. 1.—CAPSICUM PLANT, GROWN AT WASHINGTON, D. C.

FIG. 2.—SAGE PLANT, 1 YEAR OLD, GROWN AT WASHINGTON, D. C.

Yearbook U. S. Dept. of Agriculture, 1903.

BELLADONNA PLANT, 1 YEAR OLD, GROWN AT WASHINGTON, D. C.

Repeated experiments have shown that the true opium poppy grows well in many parts of this country, and small attempts at opium collection have yielded articles of high commercial grade. In spite of the large and steady market, however, opium production has not established itself as an industry.

Among conditions of especial importance, climate and labor may be mentioned. The different reports of poppy culture in Europe and the Orient seem to indicate considerable diversity as concerns soil conditions. A well drained, fairly fertile soil seems necessary. The poppy seed, drilled in rows in the spring, germinate quickly, and so rapid is the growth of the plant that in Washington, D. C., flowers begin to appear in the early summer and continue until autumn. Even as far north as Burlington, Vt., an abundant flower production occurs before midsummer and continues till frost appears. For the production of opium a dry season is necessary, but when the plants require water, irrigation can be resorted to with great advantage. The fertilized capsules are scored with a knife-like apparatus, which makes incisions shallow enough to avoid opening the cavity of the capsule. The milky juice on oozing out coagulates quickly and blackens. On the following day the hardened drops are collected and subjected to further treatment. This scoring, if rightly done, does not prevent the maturing of the seed, which are easily shaken out of the broken dried capsules. The oil from the seed is obtained by expression.

As will be readily seen from the few facts stated, the making of opium requires skilled management, much hand labor, and a proper climate. Southern California seems to have many favorable points, but lacks in general cheap labor. Some parts of Texas might more nearly meet the requirements. The growing over a wide area of seed and of capsules, for which there exists a limited demand, seems to offer little difficulty.

BELLADONNA, HENBANE, AND STRAMONIUM.

Belladonna (*Atropa belladonna* L.—Pl. XLII), henbane (*Hyoscyamus niger* L.), and stramonium (*Datura stramonium* L.) are related plants and may be discussed together. They all occur sparingly as weeds in this country, but are cultivated more or less in England, Germany, and other parts of Europe as drugs. They all grow from seed, care being taken to avoid too deep planting. A light mulch of straw over the seed, especially with belladonna and henbane, helps germination. The belladonna and henbane are biennials and produce an abundant root system, with numerous root leaves, during the first year. The flowers are produced early in the second year, and the leaves are collected while the plant is in full bloom.

With stramonium, which is an annual, flower production begins in early summer and continues until autumn, the leaves being collected when the plant is in full bloom. The seeds are also collected, usually

by gathering the nearly ripe but still unopened seed capsules, which open on drying and permit the removal of the seed by beating. Curing the leaves is usually accomplished by placing them under cover in a warm, airy place where evaporation may be steadily maintained until the leaves are dry enough to bale for the market. A good green color is thus obtained. Here the labor of collecting is an important item, in view of the usual prices obtained for the product.

The root of belladonna is also collected, the large branches of the perennial root being dug before they become woody.

CARAWAY, ANISE, AND CORIANDER.

The fruits of several umbelliferous plants meet a very considerable demand, now almost entirely satisfied from Europe. The plants producing them have long had a place in many kitchen gardens. Generally, seed production seems favored by a good, well-drained garden soil. Coriander and anise are annuals, and by planting them as early as practicable a large part of the fruit should ripen. The fact that the fruit is not all ripened at the same time introduces one of the chief difficulties in handling these plants. To command the highest prices, they should be collected before they become ripe enough to darken.

Caraway is a biennial and will not produce fruits until the second year. It grows readily from seed, and as far as its nature permits is treated like anise and coriander.

SAGE.

The supply of sage at present is obtained largely from Italy at a very nominal price. Some dealers prefer the foreign sage, because of the characteristic penetrating odor and taste which it possesses. Others, however, express a preference for the domestic article even at a somewhat higher price. At the present time the quantity of sage grown in the United States fails to supply the demand. Nevertheless, in some quarters the industry, which has but begun to develop, is experiencing a decided check through the low prices obtainable for the product. It is believed that even at the present price the crop can be grown at a moderate profit in parts of the South.

The better varieties of sage grow readily from seed and may be rapidly multiplied by cuttings. By the end of the first year the plants obtained by either method reach a size permitting a limited gathering. The crop may be harvested for from three to five successive seasons, usually without replanting. After that time it becomes desirable to reset the field. In general, the ordinary quality of sage may be obtained by cutting with a mower at such a height as to leave the woody stems, taking the more tender tip growths. The green herb is then dried in the shade on suitable frames or racks, a quick drying being desirable. The cured product may be baled for market.

WHEAT FLOUR AND BREAD.

By Harry Snyder, *Professor of Chemistry, College of Agriculture, University of Minnesota,* and Charles D. Woods, *Director Maine Agricultural Experiment Station.*

INTRODUCTION.

By far the most important of the vegetable foods in the diet of the American people are the cereals. From the results of some 200 dietary studies, carried on in connection with the cooperative nutrition investigations of the Department of Agriculture among families in widely varying circumstances in different parts of the country, it appears that on an average the different kinds of cereal products together comprised about 22 per cent of the total food and supplied 30 per cent of the total protein, 7 per cent of the total fat, and nearly 55 per cent of the total carbohydrates in the diet.

The cereals in common use are wheat, oats, corn (maize), rye, rice, barley, and buckwheat, the first three being in this country much more important than the others. For the most part they are used in the form of either flour or meal. If the latter term is interpreted broadly it will include the so-called breakfast foods that have lately come into extensive use, as most of them are little more than specially prepared meals. Such foods afford a pleasing variety in the diet, and because of special treatment in their manufacture, often including partial cooking, somewhat simplify the problem of preparation for the table. But of the various forms in which cereal products may be prepared, that which has proved the most universally satisfactory is bread made from rather finely ground meal or flour, and among all civilized people the art of bread making is highly developed.

For several years the nutrition investigations of the Department of Agriculture, particularly those carried on at the Maine and Minnesota experiment stations in cooperation with the Office of Experiment Stations, have included studies of various problems connected with the production of bread and the nutritive value of bread of different kinds. So much has been accomplished in this work that it is believed possible now to draw some definite conclusions from the results obtained. It is the purpose in the present article to consider briefly some of the facts concerning the materials from which bread is made, the changes and losses which occur in the making of bread, and the digestibility, nutritive value, and economy of bread from different grades of wheat flour.

CEREALS USED IN BREAD MAKING.

The simplest kind of bread making consists in mixing the meal or flour with water and baking it, thus producing what is known as unleavened bread, such as the "unleavened bread" of the Jews and the common cracker, or, as called by the English, biscuit. Bread of this nature is dry and hard and, unless baked in a very thin cake, is difficult to masticate. Sometimes in making crackers a little fat (shortening), as butter or lard, is added, and in some kinds baking powders are used to lighten them and improve the texture. The bread most preferred, however, is that which has been raised, or leavened, by producing in the dough a gas that will render it porous. Such bread is light and moist and easy to masticate. A few words will be appropriate here regarding the bread-making properties of the different cereals.

Meal or flour from any of the cereals may be used for unleavened bread, but leavened bread can be made only from those which contain gluten, a mixture of vegetable proteids which when moistened with water becomes viscid, and is tenacious enough to confine the gas produced in the dough. Most cereals, like barley, rice, oats, and corn, some of which are very commonly made into forms of unleavened bread, are deficient or wholly lacking in gluten, and hence can not be used alone for making leavened bread. For the latter purpose rye and wheat, which contain an abundance of gluten, are best fitted, wheat being in this country by far the more commonly used.

Macaroni, vermicelli, and other forms of Italian paste constitute a very important class of foods made from wheat. These do not resemble bread in form, though in food value and in use in the dietary they are very similar to it. Flour paste or dough somewhat similar to that used for crackers is prepared for making these materials, a flour rich in gluten being mixed with water into a paste, which is cut in various forms or pressed into rods, tubes, etc., and is then dried rather than baked. For the finest of these materials a special kind of wheat is preferred, a very hard sort, which has lately assumed importance in this country, and is known best as macaroni wheat.

The grain of rye is to some extent similar to that of wheat, but differs in some important features. It makes darker flour, and its gluten has not the same elastic tenacious quality; hence the rye loaf is not as light and well raised as that of wheat. Rye flour when used alone produces the dark-colored bread which is extensively used in European countries, in many of which it forms the staple article of diet among the poor people, rye flour there being cheaper than wheat. It is commonly regarded as inferior to wheat bread in flavor, but approaches it closely in nutritive value. In the opinion of many persons, rye flour mixed with a considerable proportion of wheat flour makes a much better bread than rye flour alone, and such a mixture is used to some extent in this country.

THE PROCESS OF BREAD MAKING.

In making unleavened bread the flour is moistened and worked into a stiff dough, which is then rolled, cut into various shapes, and baked, forming a thin, brittle biscuit or cracker. The process of making raised or leavened bread consists, in brief, in mixing the flour and water in proper proportions for making a stiff dough, together with some salt for seasoning and yeast (or other agent) for leavening. The moistened gluten of the flour forms a viscid, elastic, tenacious mass, which is thoroughly kneaded to distribute the yeast. The dough is then kept in a warm place and the yeast begins to grow, or "work," causing alcoholic fermentation with the production of carbon dioxid gas, which expands the dough, or causes it to "rise," thus rendering it porous. After the yeast has grown sufficiently, the dough is baked in a hot oven, where further fermentation is stopped by the destruction of the yeast by heat, which also causes the gas to expand in the loaf and, in addition, generates steam. The gas and steam inflate the tenacious dough and finally escape into the oven. At the same time the gluten of the dough is hardened by heat, and the mass remains porous and light, while the outer surface is darkened and formed into a crust.

When the flour is of good quality, the dough well prepared, and the bread properly baked, the loaf has certain definite characteristics. Thus, it should be well raised and have a thin, flinty crust, which is not too dark in color nor too tough, but which cracks when broken. The crumb, as the interior of the loaf is called, should be porous, elastic, and of uniform texture, without large holes, and should have a good flavor and odor.

It has already been indicated that gluten is the ingredient of the flour on which its bread-making properties chiefly depend. The important thing is not entirely the quantity of gluten, however, but more particularly its character. Two flours containing the same amounts of carbohydrates and proteid compounds, when converted into bread by exactly the same process, may produce bread of entirely different physical characteristics because of differences in the nature of the gluten in the two samples. All gluten is composed of two bodies called gliadin and glutenin, and the principal factor which determines the character of the gluten is the proportion of gliadin to glutenin in it. The gliadin, a sort of plant gelatin, is the material which binds the flour particles together to form the dough, thus giving it tenacity and adhesiveness; and the glutenin is the material to which the gliadin adheres. If there is an excess of gliadin the dough is soft and sticky, while if there is a deficiency it lacks in expansive powers. Many flours containing a large amount of gluten and total proteid material, and possessing a high nutritive value, do not yield bread of the best

quality because of an imperfect gliadin-glutenin ratio. This question is of much importance in the milling of wheats, especially in the blending of different types of wheat. At the Minnesota experiment station considerable study has been made of this and other problems regarding the bread-making properties of wheat.

Some of the Minnesota experiments were planned to test the question whether it is the starch content or the gluten content that determines the bread-making quality of flour. In certain cases the proportion of starch in a normal flour was increased 10 to 20 per cent by the addition of wheat starch, while in others it was decreased to the same extent, and in still others 10 to 20 per cent of corn flour was added to the wheat flour. In all cases the bread made from the flours containing increased or decreased quantities of starch was compared with that made from a like quantity of the normal flour. In the experiments in which the proportion of starch was increased by adding either wheat starch or corn flour there was practically no difference in either the size or the appearance of the loaf as compared with that from normal flour. The results of these tests, as well as of those made in other countries, clearly indicate that it is the gluten rather than the starch content that determines the bread-making properties of the flour.

Similarly, little difference was observed between the bread from normal flour and that from flour with the proportion of starch diminished. The proportion of starch was diminished, not by removing starch from normal flour, but by adding gluten to it. These tests likewise showed that it is not the starch content that determines the bread-making quality of the flour. They also showed that there is a limit beyond which it is inadvisable to increase the quantity of gluten in flour in order to produce a large-sized loaf. An abnormally large amount of gluten does not yield a correspondingly large loaf.

Experiments were also made to determine the relation between the nature of the gluten and the character of the bread. This was done by comparing bread from normal flour with that from other flour of the same lot, but having part or all of its gliadin extracted. Dough made from the latter was not sticky, but felt like putty, and broke in the same way. The yeast caused the mass to expand a little when first placed in the oven; then the loaf broke apart at the top and decreased in size. When baked it was less than half the size of that from the same weight of normal flour, and decidedly inferior in other respects. It was about as heavy as the same quantity of rubber. The removal of part of the gliadin produced nearly the same effect as the extraction of the whole of it, and even when an equal quantity of normal flour was mixed with that from which part of the gliadin had been extracted the bread was only slightly improved. Similar results were also

obtained at the New Jersey station in experiments with flour from which the gliadin had been extracted. From these experiments it is evident that the bread-making properties of the flour depend upon the nature of the gluten, as any alteration of the character of the gluten or the proportion of its constituents in the flour has a strong influence upon the character of the bread produced. On the other hand, when the character of the gluten or the proportion of its constituents is undisturbed a foreign proteid may be introduced without interfering with the rising of the bread. Thus, in the experiments in which corn flour was added, the proteid of the corn had no effect upon the power of expansion of the normal flour.

In flour of the highest bread-making properties the two constituents, gliadin and glutenin, are present in such proportions as to form a well-balanced gluten. From the data at hand it would appear that for the best results the proper proportion of gliadin to glutenin in hard-wheat flour is about 65 to 35 in 100 parts. Occasionally the percentage of gliadin may fall as low as 55. A large variation from this ratio has a marked influence upon the character of the bread. Advantage is taken of this fact in the milling of wheat when the blending of opposite types, one with high and the other with low gliadin content, is resorted to before grinding in order to improve the quality of the flour.

Flours of different bread-making properties may also be improved by blending after milling. At the Minnesota station experiments were made by combining a hard-wheat flour that had a high gluten content, but was relatively deficient in gliadin, with a soft-wheat flour that had a lower gluten content, but whose gluten contained a high percentage of gliadin, in such proportions that the ratio of gliadin to glutenin in the blended flour was 64 to 36. The hard-wheat flour alone produced as large a loaf as that from the blended flour, but the latter produced the best loaf. The soft-wheat flour produced a soft, sticky dough that expanded while rising but collapsed during the baking, so that the loaf was smaller than the others. These experiments indicated that flours of high food value but poor bread-making properties may be blended so as to produce a better balanced gluten than that contained in either the hard-wheat or soft-wheat flours. The bread produced, however, is not equal in quality to that from wheat normally containing a well-balanced gluten.

In the course of these experiments tests were made of the effect of the temperature of the flour when mixed upon its bread-making properties. In these tests better results were obtained with flour at 70° C. (158° F.) than with flour at a temperature considerably higher or lower. There is, therefore, a reason for the common household practice of warming flour in cold weather before mixing the dough. Care should be taken, however, not to heat the flour too much. In

the experiments referred to, keeping the flour for some time at the highest temperature (100° C. or 212° F.) had a decidedly deleterious effect upon its bread-making properties.

LOSSES OF MATERIAL IN BREAD MAKING.

All processes of bread making entail some loss aside from that of flour and dough accidentally lost in the mixing, but the greatest loss occurs during the production of leavened bread by fermentation. The action of the yeast and the heat at different stages of the process results in the fermentation of carbohydrates and the production of carbon dioxid and alcohol, and other simple bodies from the complex starches, nitrogenous bodies, etc., originally present.

Inasmuch as many of the compounds formed during the fermentation process are either gaseous or volatile at the temperature of baking, there is opportunity for appreciable loss of material. This has such an important bearing upon the nutritive value of flour that considerable study has been made of the kinds and quantities of material lost in bread making. As a result of experiments carried on at the Minnesota and New Jersey stations, it has been estimated that when care is exercised in making bread the amount of nutritive material lost need not exceed 1.5 per cent of that in the flour; but in careless bread making the loss was equal to 8 per cent of the nutritive material of the flour, and it could even be more. The loss in the former case would be equivalent to about 3 pounds of flour per barrel, and in the latter case 15 pounds or more.

This loss affects both protein and carbohydrates to an appreciable extent. Some very careful experiments in bread making, carried on as part of these nutrition investigations in a bakery in Pittsburg, showed an average loss of 1.3 per cent of the total protein and 3.2 per cent of the carbohydrates of the flour in the process. There was also a slight loss of fat, due apparently to its volatilization by the heat of the oven.

Some destruction of protein compounds in bread making is unavoidable when yeast is used, as nitrogenous material is required by the yeast for growth in the process of fermentation, but fortunately it is nonproteid rather than proteid material that is thus utilized, and the amid compounds of the flour, which have practically no nutritive value, may serve to some extent for this purpose.

The loss of carbohydrate material is due chiefly to the formation of alcohol and carbon dioxid by the yeast in growing, both being largely expelled from the bread when it is baked. In addition to these there is also a small amount of carbon lost in other forms, such as volatile acids produced during the fermentation process. As in the case of the nitrogen, some loss of this kind is unavoidable, since the production of

gas to leaven the dough is the object of the fermentation. In these experiments, in which special care was taken in the bread making, the volatile products from carbon given off were equivalent to a loss of 1.68 per cent of the total starch present. It is apparent, then, that the proper course of procedure is to stop the fermentation when sufficient gas has been produced to render the dough as porous as is desired, because further continuation of the process results simply in a destruction of carbohydrates to no purpose.

The important feature of the art of producing leavened bread thus lies in proper fermentation. Unless this process has been allowed to proceed far enough, a heavy, soggy, unappetizing loaf is the result; while if it is allowed to proceed too far there is a considerable loss of material, and an objectionable quality is imparted to the bread by the development of acid.

Several attempts have been made to introduce methods of leavening that would not cause a destruction of nutritive material. One of these is the Dauglish method, by which the so-called aerated bread is produced. This method consists in mixing the flour with water charged with carbon dioxid under pressure. The bread is about as porous as that raised with yeast, but is less agreeable to the taste of many persons, apparently because of a lack of the by-products resulting from the action of the yeast in the fermentation process. Baking powders, that is, mixtures which liberate carbon dioxid when moistened, are used to a considerable extent in making cake and quick-rising breads, biscuits, etc., but the attempts to substitute them entirely for yeast have not met with much success. Some of the objections to them are that they may be easily adulterated, and that bread made by the use of them lacks the flavor and aroma of well-made yeast bread.

THE COMPOSITION OF BREAD.

The composition of bread depends primarily upon that of the flour from which it is made. If milk and butter (or lard) are used in mixing the dough, as is commonly the case, their nutrients are, of course, added to those of the flour; but when only water and flour are used the nutrients of the bread are simply those of the flour. In either case, however, the proportions of the nutrients in the bread are smaller than those in the flour, because a considerable part of the moisture from the water or the milk used in mixing the dough is present in the bread after baking, that is, a pound of the bread would contain less of any of the nutrients than a pound of the flour, because the proportion of water in the bread is greater. The following table shows how the composition of flour compares with that of bread, the different kinds

of bread all having been made from the flour with which they are here compared:

Composition of flour and of bread made from it in different ways.

Material.	Water.	Protein.	Fat.	Carbohydrates.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Flour	10.11	12.47	0.86	76.09	0.47
Bread from flour and water	36.12	9.46	.40	53.70	.32
Bread from flour, water, and lard	37.70	9.27	1.02	51.70	.31
Bread from flour and skim milk	36.02	10.57	.48	52.63	.30

It is thus shown that the proportion of water is larger and that of each nutrient smaller in bread than in flour, and that the nutrients of the flour are increased by those of nutritive materials added in making the bread.

It is apparent that two kinds of bread from the same lot of flour may differ, according to the method used in making the bread. On the other hand, two loaves of bread made by exactly the same process, but from different lots of flour of the same grade or brand, would not necessarily have the same composition because of a possible variation in the flours. The chemical composition of wheat is not a fixed characteristic, different kinds of wheat varying widely in this respect. Furthermore, the composition of the same sort of wheat varies with several factors, such as climate, rainfall, and the soil on which it is grown. It is evident, therefore, that statements regarding the composition of flour can hardly be definite.

GRAHAM, ENTIRE WHEAT, AND STANDARD PATENT FLOURS.

Inasmuch as the composition of bread is so dependent upon that of the flour, a consideration of the different grades of flour on the market will afford an understanding of how the breads from them compare in this respect. Attention is here given more particularly to Graham, entire wheat, and standard patent flours, as these are the three grades most commonly used, and hence of most importance. Graham flour, strictly speaking, is simply wheat meal, that is, the entire grain ground to a powder. It has sometimes been made by removing the outer branny portions of the kernel and grinding this separately from the inner parts, afterwards combining the two, as it was thought that the efforts to grind the naturally coarse material with the rest of the wheat had a deleterious effect upon the bread-making qualities of the flour. It is now commonly made by crushing and grinding the whole of the kernel at once, without bolting or sifting. When thus prepared it contains the same ingredients as the wheat itself and in the same proportions. Such flour is coarse, however, and even the most

successful attempts at fine grinding still leave it fairly coarse and with a large proportion of branny particles. To overcome this objection more or less bolting is frequently resorted to. Much of the flour sold as Graham has been thus treated, though, of course, such a product is not really Graham flour.

The term "entire wheat" would suggest flour practically identical with the Graham. The flour thus designated, however, it is often said is made by first decorticating the grain, or removing the branny outer covering, and grinding the remainder. By such a method some of the outer portion of the wheat kernel would be retained in the flour, only a small proportion of the wheat being discarded. So far as can be learned some of the so-called whole-wheat flour is not so ground, but is made by including with the patent grades the middling and low-grade flours with considerable of the germ. Whole-wheat flour is not so coarse as Graham nor so fine as the white flours.

The finer grades of patent flour contain neither the bran nor the germ of the wheat. In some of the lower grades the germ is retained, and as this part is somewhat richer than the rest of the kernel in protein, the proportion of this ingredient is larger in the lower than in the higher grades of flour. The chief reason for removing the germ in milling the higher grades is that, because of the presence of the oil, which is more abundant in the germ than in the remainder of the wheat, flour in which it is retained has a tendency to become rancid and to deteriorate in bread-making properties. The bran is left out because of its coarse nature and because it darkens the flour. The grade of white flour most widely used is that known as straight patent, or standard patent, or family grade. Although this flour contains neither the germ nor the bran of the wheat, in modern exhaustive milling nearly 73 per cent of the kernel is recovered in this grade.

Because the proportion of nitrogenous material in both the germ and the outer portions of the wheat is larger than in the remainder of the kernel, it has been popularly contended that the flours from which these portions have been removed are less nutritious than those in which they are retained in the milling. In support of this contention the different grades of flour have frequently been compared with respect to the proportions of protein in them, apparently to the advantage of the coarser grades. In consideration of what has already been shown regarding the variable composition of wheat, however, it is evident that differences in the proportions of nutrients in the different grades of flour as purchased in the market would much more likely be due to differences in the wheat from which they were ground than to advantage in any particular method of milling. Patent flour from wheat with 15 per cent of protein would contain larger proportions of the nutrient than Graham flour from wheat with only 8 per cent, such differences in protein content being not at all uncommon. Obviously,

therefore, the only fair comparison is that between the three grades of flour milled from the same lot of wheat. These points are clearly illustrated by the figures in the following table, perfectly uniform results having been obtained at both the Maine and Minnesota experiment stations:

Composition of flours and breads, as shown by recent experiments.

Material.	Water.	Protein.	Fat.	Carbohydrates.	Ash.
Minnesota wheat flour (fresh material):	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
First patent	10.55	11.08	1.15	76.85	0.37
Second patent	10.49	11.14	1.20	76.75	.42
Standard patent	10.54	11.99	1.61	75.36	.50
First clear	10.13	13.74	2.20	73.13	.80
Second clear	10.08	15.03	3.77	69.37	1.75
"Red dog"	9.17	18.98	7.00	61.37	3.48
Entire wheat	10.81	12.26	2.24	73.67	1.02
Graham	8.61	12.65	2.44	74.58	1.72
Oregon wheat flour (fresh material):					
Standard patent	8.94	7.55	1.25	81.82	.44
Entire wheat	8.66	8.25	1.67	80.35	1.07
Graham	8.15	8.97	1.68	79.48	1.72
Oklahoma wheat flour (fresh material):					
Standard patent	9.93	15.06	.92	73.57	.52
Entire wheat	7.46	16.63	1.64	73.05	1.22
Graham	7.73	16.81	1.79	72.35	1.32
Bread made from Oregon wheat flour (water-free basis):					
Standard patent	....	8.32	1.37	88.93	1.38
Entire wheat	....	9.49	1.82	87.24	1.45
Graham	....	9.94	1.83	85.72	2.51
Bread made from Oklahoma wheat flour (water-free basis):					
Standard patent	....	16.24	1.02	82.03	.71
Entire wheat	....	18.06	1.77	78.75	1.60
Graham	....	18.43	1.94	77.12	2.51
Bread made from patent flour (fresh material):					
High grade	32.9	8.7	1.4	56.5	.5
Standard grade	34.1	9.0	1.3	54.9	.7
Medium grade	39.1	10.6	1.2	48.3	.9
Low grade	40.7	12.6	1.1	44.3	1.3

For the experiments with Minnesota wheat the flours were ground by one of the large mills in Minneapolis. In addition to the three flours under discussion, all the grades of flour commonly ground were produced from this wheat, and obtained for analysis, the results being given in the table. The first patent is the highest grade of flour manufactured; the gluten in it has a greater power of expansion than that in any other grade, and the loaf made is the largest and whitest. Second patent is somewhat similar to first patent, but the gluten has not quite so high a power of expansion, and the bread is a shade darker. The first clear grade, which comprised about 12 per cent of the wheat, is obtained after the first and second patent have been removed. This

grade contains slightly more protein than either of the two patent grades, but the gliadin and glutenin are not present in such favorable proportions for bread making. All three of these flours are combined to produce the straight or standard patent flour. The quantity of first or second patent flour put upon the market is relatively small compared with that of standard patent.

After the standard patent flour has been removed there is still obtained about 0.5 per cent of a flour called second clear, or low grade, which contains a high percentage of protein, but with a gluten of poor quality for bread making. Finally there is the so-called "red dog" flour, the lowest grade produced, which is secured mainly from the germ or embryo and adjacent parts of the wheat. It contains large proportions of protein and fat, but the proteids of the wheat germ are decidedly different from gluten in character and composition. Germ flour has poor agglutinating properties, and little power of expansion, and produces a poorly raised, dark-colored loaf.

The entire wheat flour included in this list was produced by removing a portion of the bran coat and grinding the remainder of the kernel. The Graham flour was made by grinding the whole of the grain, bran and all, no sieves or bolting cloths being used.

The Oregon wheat and the Oklahoma wheat were both ground at the Minnesota station in a small mill procured especially for the investigations. Only the standard patent, entire wheat, and Graham flours were produced from either of these wheats. It will be noticed that the Oregon wheat was much poorer in protein but richer in carbohydrates than the Oklahoma wheat, while the Minnesota wheat was about midway between. The analyses of these samples will serve to illustrate what has been stated above regarding the comparison of different grades of flour from different lots of wheat. Graham flour from even the Minnesota or the Oklahoma wheat had a larger protein content than the standard patent from the same wheat; but, on the other hand, the standard patent from either had much more protein than the Graham from the Oregon wheat. It is quite apparent, therefore, that a comparison of composition of the different grades from different lots of wheat is not a fair one.

Comparing the three grades of flour from the same lot of wheat, it will be noticed that in each case the proportion of protein was largest in the Graham and smallest in the standard patent flour, the entire wheat being between these two. On the other hand, the proportion of carbohydrates was smallest in the Graham and largest in the standard patent flour. Considering that these two nutrients are not present in flour in proper proportions for a well-balanced diet, there being an excess of carbohydrates and a deficiency of protein, it might seem from such a comparison of composition that the coarser flours would be the best. Before an adequate discussion of relative nutritive value

is possible, however, the digestibility of the three flours must be determined.

The breads from the different flours, when made in such ways as to afford comparison, bear the same relation to one another as the flours in respect to the proportions of nutrients. This is what would be expected in view of the fact, already stated, that except for the materials added in mixing the dough the composition of the bread depends entirely upon that of the flour. The analyses of breads included in the table will illustrate this. Thus, in the breads made from different grades of patent flour, that from the high-grade flour, which had the lowest protein content, had the least protein, while that from low-grade flour, which is the richest in protein, had the most. This was the case with the breads of which the analyses are given in the table, even though the proportion of water is highest in the bread from the low-grade flour; if the computations were based upon the dry matter of the breads the differences would be still larger. In the case of breads made from the different grades of Oregon and Oklahoma wheat, the values given are for dry matter, in order that the comparison may be absolute. These data show that in each case the Graham bread had the most protein and the least carbohydrates, as it was with the flours.

THE DIGESTIBILITY OF BREAD.

A knowledge of the digestibility of any food material is of prime importance for two reasons: In the first place, unless it is completely digested a portion of it does not serve to nourish the body at all, because only that part of the food that is digested and absorbed from the alimentary canal can be thus utilized, and, in the second place, some indigestible materials act as irritants in the alimentary canal, and while they may stimulate the excretion of the digestive juices they sometimes increase peristalsis, thus hastening the contents along too rapidly to permit complete absorption, with the result that nutritive material which otherwise might be absorbed and serve to nourish the body is lost with the indigestible materials. In estimating the nutritive value of a food material, it is therefore necessary to consider not only its composition, but also, and more particularly, the proportions of its different nutrients that are digested and utilized.

In connection with the nutrition investigations at the Maine and Minnesota stations, upward of 100 digestion experiments have been made with young, healthy men, with bread from different grades of flour ground from hard and soft wheats from Indiana, Michigan, Minnesota, Dakota, Oklahoma, and Oregon. In these investigations great care was given in each case to the securing of different grades of flour from the same lot of wheat, to the production of bread from the flours, and to all other details of the experiments, in order to secure

uniformity of conditions, and thus insure fairness and reliability in comparison. The results of these experiments therefore give very definite information regarding the relative digestibility of bread from different grades of flour.

The larger number of these experiments were made with Graham, entire wheat, and standard patent flours from wheats from different sections of the country. The averages of the results with these three grades of flour give the following as the proportions of nutrients that were digested from the different flours, these factors being commonly termed coefficients of digestibility: Standard patent flour, protein 88.6 per cent and carbohydrates 97.7 per cent; entire wheat flour, protein 82 per cent and carbohydrates 93.5 per cent; Graham flour, protein 74.9 per cent and carbohydrates 89.2 per cent.

The digestibility of the fat was also determined in some cases, but for the most part the results were believed to be too low, and are therefore omitted. The quantity of fat in bread is too small to permit of accurate tests of its digestibility. This is a matter of no importance, however, as bread is not considered as a source of fat in the diet. The very common custom of eating butter or some other fat with bread is in reality but a method of supplying this deficiency.

It will be seen that there is a considerable difference in the digestibility of the nutrients in the three kinds of bread, the variations in the protein being larger than those in the carbohydrates. For both nutrients the digestibility of the standard patent flour was the greatest, and that of the Graham flour was least. This is true not only for the averages of the tests with the different flours, but also for the individual tests. With some of the wheats the differences in the proportions digested from the different flours were not so wide as with others; and in some cases also there were very noticeable differences between the subjects with respect to the completeness of digestion; but with all the subjects, and with all kinds of wheat thus far tested, the uniform result was that the digestibility of the standard patent flour was the highest, that of entire wheat the next, and that of Graham the lowest. Concordant results were obtained in artificial digestion experiments.

Experiments were made with first, second, and standard patent flours to learn how these compare with one another, the digestibility of the nutrients as determined in these tests being as follows: First patent, protein 90.5 per cent and carbohydrates 98 per cent; second patent, protein 91.4 per cent and carbohydrates 98.7 per cent; standard patent, protein 90.3 per cent and carbohydrates 97.4 per cent.

Practically, there was no difference in these three grades of patent flour with respect to the proportions digested; and since the proportion of protein is much the same in all of them, they are about equal in actual nutritive value.

Differences in digestibility of the flours containing the branny portion of the wheat are sometimes attributed to the fineness with which

the coarse materials are ground. This is doubtless true to some extent, and may in part explain why whole wheat is more digestible than Graham, because the whole-wheat flour is somewhat more finely ground. But even when bran is reduced to a very fine powder it is not so well digested as flour, and its presence in the flour decreases rather than increases its nutritive value, because it decreases the digestibility. This was observed at the Minnesota station in some experiments with Oklahoma wheat. Bran removed in producing the patent flour was ground very fine, and was added to some of the flour, 14 per cent as much bran as flour, or about the proportion in which it was removed during the milling. This increased the protein content of the flour to 15.3 per cent as compared with 15.1 per cent in the flour without the bran. The digestibility of bread made from this mixture, as compared with that of bread from the same flour without the bran, was as follows: Bread with bran, protein 85.9 per cent and carbohydrates 93.3 per cent; bread without bran, protein 91.6 per cent and carbohydrates 97.8 per cent.

Thus, while the addition of the bran to the flour increased the proportion of the nutrients but a trifling amount, it decreased the digestibility very decidedly, so that the digestible nutrients in the flour with bran were only 13.2 per cent of protein and 67.5 per cent of carbohydrates, while in the same flour without the bran they were 13.8 per cent of protein and 71.1 per cent of carbohydrates. What little was gained in increase of nutrients by the addition of the bran was more than offset by the failure of the bran to be digested. It is evident, therefore, that the defective digestibility of the bran is not due entirely to imperfect grinding, though it is worthy of note that the bread from the mixture of ordinary flour and finely ground bran was more digestible than that from either Graham or entire wheat flour from the same lot of wheat.

A number of experiments were also made to study the effect of adding germ to patent flour. As in the experiments with bran, the germ removed in milling standard patent flour from Oklahoma wheat was finely ground and mixed with some of the standard patent flour in the proportion in which it was removed during the milling, the mixture containing about 93 per cent flour and 7 per cent germ. The digestibility of the nutrients of bread made from this mixture was as follows, the data for the patent flour without the germ being also given for comparison: Bread from mixture, protein 90 per cent and carbohydrates 97.6 per cent; bread from patent flour, protein 91.6 per cent and carbohydrates 97.8 per cent.

The digestibility of the protein in the flour with the germ added was slightly less than in the same flour without the germ, while that of the carbohydrates was practically the same in both. The digestible nutrients in the flour with the germ, computed by use of these results,

would give a trifle more protein and slightly less carbohydrates than in the flour without the germ. There was, therefore, practically no gain in nutritive value by retaining in the flour the germ that is ordinarily removed in the milling.

THE NUTRITIVE VALUE OF BREAD.

As previously pointed out, bread contains from 35 to 40 per cent of water. Since the remainder, about 60 per cent at least, is nutritive material, bread is really one of the most nutritious of the common foods, but few others equaling it in this respect. Bread supplies a large amount of carbohydrates, a moderate amount of protein, a small amount of mineral matters, and almost no fat. Since there is relatively an excess of carbohydrates and a deficiency of protein in wheat, bread could not serve alone for proper nutrition of the body, because an amount of bread sufficient to supply the requisite protein would furnish much more carbohydrates than necessary. In a mixed diet this discrepancy is of little importance, because the deficiency of protein is made up by such foods as meat or cheese. Bread and milk forms a much more suitable diet than bread alone. Where bread forms the whole or the main part of the diet, as it does among the larger number of poor people, and when flours of low protein content are used, the deficiency of protein is of much more consequence. In case of flours of high protein content this deficiency is of course smaller.

Various methods of increasing the protein content of bread have been followed, but only a few of them have been adopted for ordinary practice, because of a tendency to increase the cost of the bread too much. The use of skim milk instead of water for mixing the dough does not increase the cost of the bread very materially, but it does add appreciably to the protein content. A comparison of skim-milk bread with water bread, made from the same flour, is given in the table on page 354, showing that the skim milk increased the protein to the extent of about 2 per cent.

CONCLUSION.

In this discussion especial consideration has been given to the protein and carbohydrates, and no mention has been made of the mineral matters, among which are the phosphates of the wheat so popularly considered of especial virtue. This omission has been intentional for the reason that as yet not enough is known concerning the metabolism of mineral matters in the body to warrant a discussion of the value of those contained in the flour. Such investigations as have been made suggest that the supply in the ordinary diet is more than sufficient to meet the demands of the body. In the experiments it was observed that the quantity of mineral matters in the feces was from a third to a half as large as those in the bread, but it can not be said how much of

the excreted material pertained to undigested bread and how much was from other sources. In view of such lack of knowledge it would be futile as yet to compare the three grades of flour with respect to their value as sources of mineral matter.

While the coarser grades are not more nutritious than the finer flours, there are many cases in which they are especially desirable, as, for instance, for persons of sedentary habit and occupation, because their stimulating of the alimentary tract may help to procure a larger secretion of the digestive juices and also to overcome a tendency to constipation. This, however, is a purely physiological action, and should be considered apart from the nutritive value. Finally, it may be said that wheat flour of all the various grades is one of the cheapest, most digestible, and most nutritious of human foods, and well worthy of the high estimation in which it is generally held. The use of different sorts of wheat flour is a convenient way of giving variety to the diet, a matter which is of no little importance.

A MODEL FARM.

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INTRODUCTION.

The methods of management on a 15-acre farm that raises all the roughage for 30 head of stock, 17 of which are cows in milk, can not fail to be of interest to farmers in all parts of the country. The farm in question is situated in southeastern Pennsylvania, near a large city. About 13 acres are in cultivation, the remaining 2 acres being occupied by buildings, yard, etc. This farm came into the possession of the present owner in 1881 with a mortgage of $7,200 upon it. For the first year the farm lacked $46 of paying expenses. During the next six years the mortgage was paid.

HOW THE SOIL WAS IMPROVED.

The soil of the farm is a reddish, somewhat gravelly clay. It was so run down in 1881 that it did not support the 2 cows and 1 horse kept upon it. It has been brought up to its present remarkable state of fertility solely by the use of stable manure applied directly from the barn, as it was produced. The system of handling manure is such that none is lost, either liquid or solid. No commercial fertilizers have ever been used, and no manure has been hauled from the city. The crops are (ordinarily) all fed, and are thus largely returned to the land in the manure. Of course, much valuable fertilizer is added to the farm annually from the rich mill products fed the cows.

Upon assuming management of the farm the owner, a minister, with no previous experience in farming, began to read what agricultural literature was available. One of the first books secured was Quincy's little book on the soiling of cattle, written in 1859. As in many parts of this country the practice of "soiling" is not common, it is permissible to state that it consists in cutting and feeding green feed in summer instead of allowing the animals to run on pasture. This practice did not prove satisfactory the first year, because no other feed was used, and the cows did not do well. The manure was also difficult to handle, and it was not easy to keep the barn clean. Before the next season the new farmer had procured Stewart's book on feeding animals, and from it learned his first lesson in "balanced rations."

He also learned to feed some dry hay with the soiling crops, thus giving the manure a proper consistency. Thenceforward the management of the constantly growing herd of cows was a simple matter, and the farm began not only to pay a profit but to increase in fertility.

SYSTEMATIC MANAGEMENT.

The writer has never seen another farm on which system is so pronounced a feature. Without referring to notes of any kind, the owner detailed the crops growing on each small subdivision, the crops that had been grown on each for two to three years past, and those that would be grown for as long in the future. In most cases the dates of seeding and harvesting were given. A peculiar feature of the management is that all the principal operations are performed on a fixed day each succeeding year, or as near to it as the weather will permit. Not a pound of solid or liquid manure goes to waste on this farm, and the soil is in such condition that it is more nearly independent of weather conditions than any other soil the writer has ever seen. Torrential rains are soaked up in a very short time, so that the soil may be handled after a rain much sooner than that of adjacent farms. It is therefore not difficult to adhere approximately to a prearranged programme. For instance, early corn for soiling is planted May 8; late corn for silage, June 22; grass seed about August 22, and so on.

THE PRODUCTS SOLD.

The farm is strictly a dairy farm, the only products regularly sold being milk and a few head of young cattle each year. The cows are all registered Jerseys, except one or two picked up at sales on neighboring farms. They are not only pure bred but they are well bred. There is not a star boarder in the herd. Male calves, if worthy of it, are reared for breeding purposes, but none is ever vealed. If a male calf is not fit to raise for a breeder it is killed at birth. "It doesn't pay to feed $18 worth of milk to a calf that will sell for $7," said the owner. The young cattle sold from this farm bring on an average $100 apiece, and about five are sold each year.

The milk is all sold at 25 cents a gallon the year round to a State institution located 2 miles distant, in a neighboring suburb. It tests on the average 5.8 per cent. It will be seen that this is a very moderate price, considering the quality. It is superfluous to add that this milk is perfectly clean and free from adulteration. There is never any complaint from the buyers; on the other hand, this farmer is considered a public benefactor. The milk is delivered once a day, the wagon leaving the farm at 6.50 a. m. Both night's milk and morning's milk is scrupulously cared for the first hour after it is drawn. As soon as drawn it is placed in perfectly clean cans standing in cold water some

distance from the barn, and stirred frequently to aerate it and aid the cooling. The milk vessels are never allowed to stand around with a little milk left in them, but are washed as soon as the milk is removed from them, first with cold water, then with boiling, and finally again with cold water. "All buckets and cans about the dairy are treated to such a bath immediately after use and placed in the sunshine and air, and before use again cleansed with clean cold water." The amount of milk produced is nearly the same at all seasons, and averages about 26 gallons a day. This is equivalent to a yield of 4,800 pounds a year for each of the 17 cows kept—not an enormous yield by any means, but a good one. This gives an income from milk of about $2,400 a year. The outlay for concentrated feeding stuffs is about $625 a year.

HANDS EMPLOYED AND METHODS OF WORK.

One man and a boy do the labor of the farm, except in hay harvest and during the cutting of silage; but these have all they can do. The owner does only such portions of the ordinary labor as can not safely be entrusted to hired help; but he plans all the work, and then sees that his plans are followed strictly. So systematic is the work that the owner may leave for a week without notice to his laborers, with no interruption to the regular routine. The feeding of the cows, the methods of handling the milk, of keeping the barn clean, and of disposing of the manure are all worked out so perfectly that they require very little supervision on the part of the proprietor. On a farm of this size, with such high-priced land, pastures are out of the question. There is not even a barn lot. The 30 head of stock remain in the barn the year round. We have been taught that this is not the best practice. It has been supposed that milch cows need a certain amount of exercise. But how much excercise do Danish cows have, that stand in their stalls from November to May, and are staked out in the field from May to November? Yet Denmark is a dairy country par excellence, and her cows are healthy.

THE COWS AND THEIR FEED.

On the farm here described the bill for veterinary services during the past six years has been $1.50, and this was made necessary by an accidental injury to one of the cows. One of the cows is 15 years old, and is still vigorous and healthy; she breeds regularly, and gives milk enough to make it profitable to retain her in the herd. A photograph of this cow is shown in Pl. XLIII, fig. 2; and her two-year-old daughter, a very promising cow, appears in Pl. XLIII, fig. 3. The writer has never seen a thriftier, better kept herd of cows. They are fed balanced rations every day in the year. Every feed consists of three parts. A

portion of it is some succulent material—silage in winter; and rye, timothy and clover, corn, or peas and oats in summer. A second portion consists of dry hay or fodder. This is used to give the manure proper consistency, and adds much to the convenience of caring for the cows. A third portion consists of mill products, of which three kinds are used—bran, oil meal, and gluten. The proportion of concentrates fed depends on the condition of the cow, and is regulated by the flow of milk and the consistency of the manure.

The soiling crops used are as follows: Green rye, beginning about May 1, and continuing about four weeks, or until the rye is ready to cut for hay. Then timothy and clover are fed till peas and oats are ready. When the latter is cut for hay, the silo is opened (about July 4), and silage is fed till early corn (planted May 8) is ready. Enough early corn is planted (about one-fourth acre) to last till late corn (planted about June 22) is ready. Late corn is then fed till it is time to put it in the silo. From this time forward silage is fed daily till green rye is available in the spring. No abrupt change is ever made in the system of feeding. Even the change from green corn to silage is made gradually.

It will surprise most dairymen to learn that these carefully kept cows are given 4 ounces of salt each, daily, mixed with their feed. They eat their food better, and the owner thinks they do better when given this amount than when the allowance is smaller. The cows are fed three times a day, and the salt is divided between the three feeds. Fine table salt is invariably used; the cows prefer it to coarse salt.

Every particle of roughage fed on this farm, including hay and all soiling crops, is cut in quarter-inch lengths. Even the bedding is cut in this manner.

There are two round silos on the farm (see Pl. XLIII, fig. 1), each 10 feet in diameter and 34 feet high. These together hold about 100 tons of silage, and this quantity of corn silage is produced on 4 acres, planted about June 22. Eleven men, 3 teams, and a traction engine to run the cutter are employed in filling the silos. Ensiling begins usually on Friday, so that the silage may settle over Sunday. On Monday the filling is completed.

CROPS AND MANAGEMENT.

There is no systematic rotation of crops on this farm. It is not necessary, since every foot of land receives an abundance of manure every year or two. The writer visited the farm late in April, and only three kinds of undesirable plants were to be seen. These were not weeds in the ordinary sense, for they did not interfere to any marked extent with the crops. In a three-year-old plat of timothy and clover, chickweed was more or less abundant. This, of course, disappeared when the grass began to grow vigorously a little later. In a two-year-old

field of the same crop, dandelion was more or less abundant. In a small plat devoted to corn last year, and left for early corn this year, shepherd's purse grew quite rank.

Every green crop grown on the place is utilized for soiling purposes, more or less, the surplus being converted into hay or silage. The crops grown are rye, timothy and clover, corn, peas and oats, and millet. At least two crops a year are harvested from most of the fields. The grass crop is a mixture, the seed sown being as follows: Red clover, 6 quarts; timothy, 5 quarts; alsike, 2½ pounds, and redtop 1 pound. The farm is divided into twelve small parcels, varying in size from one-fourth acre to 2¼ acres. In April, 1903, six of these (5 or 6 acres in all) were in grass. About half of this was sown the last week in August, 1900, one-fourth in 1901, and one-fourth in 1902. That sown in 1900 was cut once for hay this spring (1903), and then plowed for late corn. The crops which preceded these plats of grass were in two cases rye, grown the preceding winter; when this was cut for soiling or for hay the ground was plowed and harrowed into fine tilth. One and a half bushels per acre of German millet were then sown. This was cut for hay before it had made seed. The land was plowed again and harrowed into fine tilth. Grass seed was then sown broadcast, late in August. Sowing thus early, using no nurse crop, gives a full crop the next year. In fact, because of the remarkable state of fertility to which this formerly exhausted soil has been built up, three large crops are cut the next year after sowing grass in August. Two cuttings are made the second year. In the spring of the third season, if the crop promises to be abundant, a crop of hay is taken before breaking up the sod for late corn. If the grass crop is scanty, the sod is broken earlier for any crop for which it may be needed. The sod is always heavily top-dressed during the winter before it is broken up.

Some of the fields are kept in rye in winter and corn in summer, indefinitely. Rye is sown broadcast at the rate of 2 bushels per acre, the seed being covered by a spring-tooth harrow. The hay made from this rye is readily eaten by the stock, but a part of it is used for bedding. During the present season rye attained a height of 7 feet 11 inches. Three of the twelve subdivisions of the farm are thus devoted regularly to rye in winter and late corn in summer. Oats and peas are sometimes sown in early spring on land sown in rye the previous fall, the rye having been turned under in spring. Sometimes a piece of corn land is left bare during winter and sown to oats and peas next spring. Grass is occasionally sown on land from which soiling corn has been cut. One small field was devoted to oats and peas for several years and then put down in grass, to be followed by corn. Oats and peas do not fit very well into the cropping systems followed on any of these small fields. They must be sown in early spring, and are off

early in July; yet they yield so large a quantity of such nutritous hay or soiling material that a small area is usually grown each year. It is unfortunate that no records of actual yields are kept. But since the stock are all kept in the barn the year round, it is not difficult to estimate approximately the amount of dry matter in hay, silage, etc., the farm must yield. Estimating that 17 cows consume 16 pounds, 11 head of young cattle 10 pounds, and two horses 12 pounds of dry matter each daily in their roughage, the total amount of dry matter thus consumed is equal to that contained in 87 tons of hay containing 15 per cent moisture. This is equivalent to 6.7 tons of hay for every acre in cultivation on the farm. Not only did this farm produce all the roughage for 30 head of stock last year, but a surplus of 3,300 pounds of hay was sold. A small portion of this year's hay crop has also been sold.

The remarkable yields on this farm are due to the intelligent use of stable manure. Most farmers waste more than half the value of the manure produced on their farms. It is estimated that five-eighths of the plant food in the manure of farm animals is contained in the liquids. On this farm every particle of this plant food is utilized.

HANDLING THE MANURE.

The method of handling manure on this farm can be used only on farms on which stock is kept in stalls, and it is therefore not applicable to all styles of stock farming; but it is so unique, so perfectly systematized, and bears such an intimate relation to the success attained that an account of the farm would be incomplete without a full statement of it. Behind each row of cows is a gutter 18 inches wide and 7 inches deep. These gutters have no outlets. They are thoroughly cleaned daily. (The whole barn is disinfected twice a week by a free use of creoline, and the interior is frequently whitewashed.) When cleaned, the gutters are sprinkled with ashes or dry dirt to absorb what moisture may be present. During the day a quantity of absorbent, consisting of leaf mold, rotten sod, etc., is placed in them. Each gutter ends near a door. The manure is lifted from the gutter into a cart backed up to the door. The end of the gutter next the door is slightly lower than the other end. One man lifts the manure with a fork and places it in the lower end of the trench. A second man then lifts it into the cart. In this manner the liquid manure is all gotten into the cart. Finally, the fragments that remain in the trench are swept to the lower end and removed. The cart goes immediately to the field, and the manure is spread at once. (See Pl. XLIV, fig. 1.) In summer it is spread on the land from which the soiling crops are removed. In winter it is spread on the rye and grass fields—on the latter particularly when the ground is too soft to place it upon the rye fields. No manure is used on newly

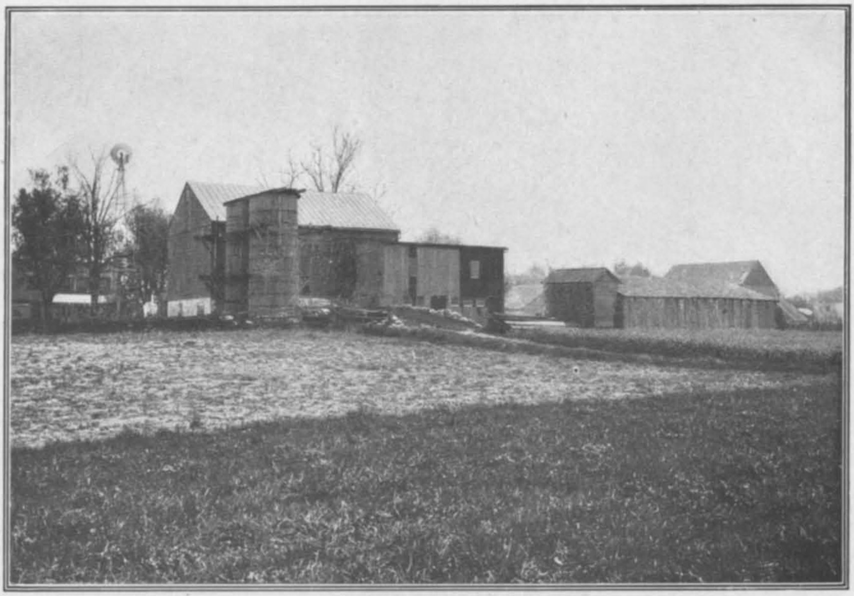

FIG. 1.—FARM BUILDINGS ON THE MODEL FARM.

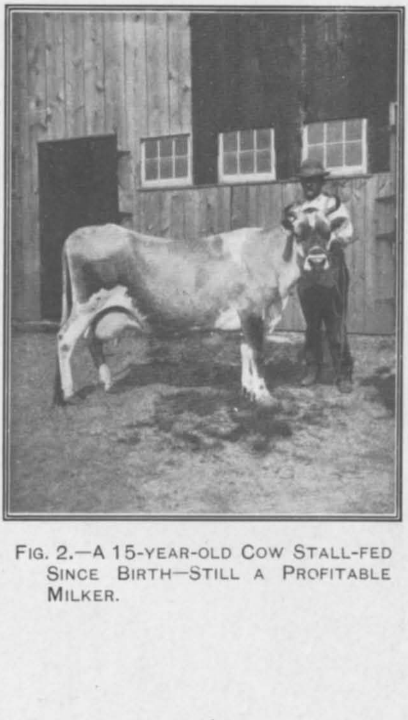

FIG. 2.—A 15-YEAR-OLD COW STALL-FED SINCE BIRTH—STILL A PROFITABLE MILKER.

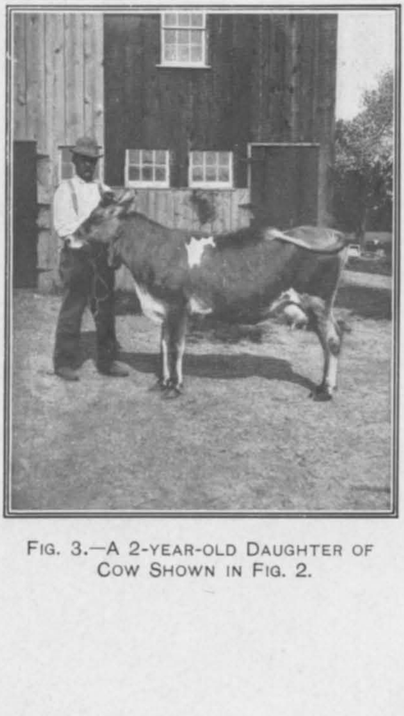

FIG. 3.—A 2-YEAR-OLD DAUGHTER OF COW SHOWN IN FIG. 2.

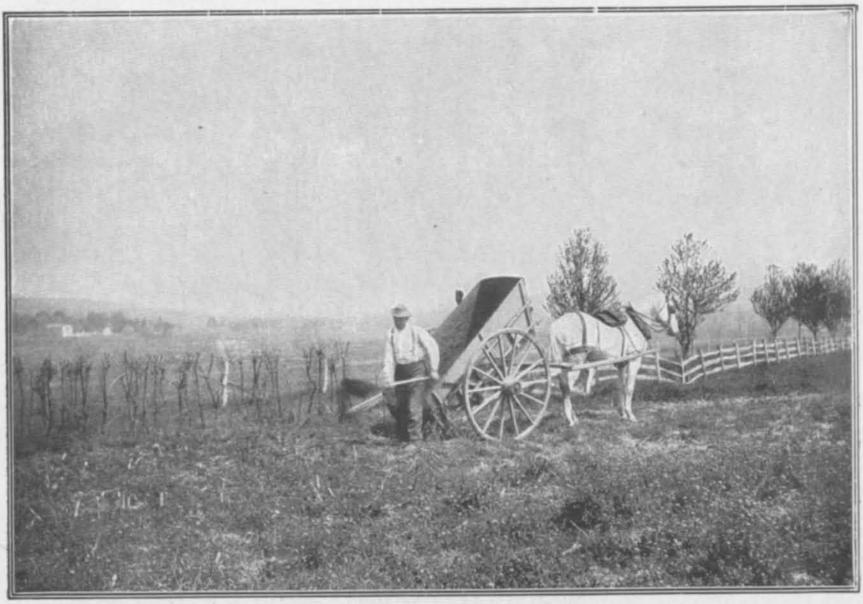

FIG. 1.—HANDLING MANURE ON THE MODEL FARM.

FIG. 2.—FIELD OF RYE ON THE MODEL FARM IN APRIL.

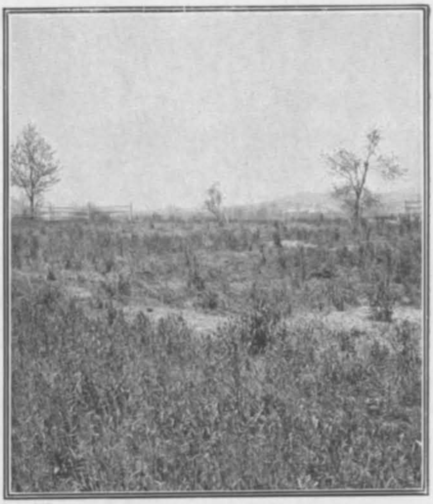

FIG. 3.—FIELD OF RYE ON ADJACENT FARM WITH SAME SOIL CONDITIONS SHOWN IN FIG. 2.

seeded grass lands, but the second and third year grass fields are top-dressed in winter. "We always have a place to put manure," said the owner of this farm, and this is the secret of his large crops. Pl. XLIV, fig. 2, shows a field of rye on this farm, while fig. 3 shows a similar crop on exactly similar soil on another farm, the two views being taken within a few feet of each other.

CURING HAY.

Harvesting hay on this farm is an interesting process. The rank growth of the crops renders it necessary to move aside the swath cut before the machine can get at the next one. The method of curing is as follows: "The grass is cut in the afternoon. The first night's dew never hurts it. Let it lie the next day until noon. It is then put into curing cocks, which are made flat. These cocks are upset the next morning, and in the afternoon four of them are made into one weathering cock. Let it stand thus for one day; then haul to the barn or rick."

CONCLUSIONS.

We have given the account of a pioneer farmer, starting in with no experience, but going to work in a methodical manner to learn what he could from the experience of others, making a careful study of surrounding conditions, and adjusting himself to those conditions. This farmer, by applying scientific principles and business methods, has blazed a path into a region of great possibilities. The most important lesson to be learned from his achievements is that, by applying such methods, it is possible to cause land to yield twice or three times as much as the present average from what are considered good methods.

Can this experience be duplicated on other farms? The answer to this question depends on the soil and the man who has the management of it. It can not be done by the man who is not a student. Few men, indeed, could develop unaided a system such as that described, but there are many who can do it now that the methods by which it has been accomplished are common knowledge.

A very similar system may be developed on any dairy farm that dispenses with pastures. Where land is cheaper and the dairyman can afford pastures, the system would be radically different in summer, but not in winter; while altogether different methods are required on other than dairy farms.

The most important single feature of this farm, aside from the remarkably systematic way in which it is conducted, is the manner of handling the manure. The fact that the stock are all stabled the year round makes it possible to save all the manure, both liquid and solid,

and apply it to the land. Again, the fact that it is applied daily, as produced, insures that any leaching by rains shall carry the leached materials into the soil, where it is wanted. How much plant food is lost from fermentation after the manure is spread on the fields is not known. But the remarkable yields of every portion of this farm would seem to indicate that this method of handling manure is highly satisfactory.

That similar results as to yield of crops may be accomplished by the use of commercial fertilizers, combined with crops grown expressly for the production of humus, is shown by the experience of a number of farmers, particularly in the truck-growing districts. It may, therefore, prove possible to develop almost any type of farming to a point that will more than double present average yields if agricultural science continues to develop as rapidly during the next quarter of a century as it has during the last.

SOME NEW FACTS ABOUT THE MIGRATION OF BIRDS.

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INTRODUCTION.

What becomes of our summer birds? Where do they spend the winter? By what routes do they travel to their destinations? How do they find their way? For many centuries these and similar questions have puzzled the brain of man. In default of exact knowledge, fanciful theories have been advanced, such as that swallows hibernate in the mud, and that small birds cross the Mediterranean as passengers on the backs of cranes. Such notions have held their own well into modern times. Scarcely a hundred years have elapsed since systematic knowledge on the subject began to accumulate, and only in the last half century has there resulted any noteworthy progress toward a solution of the questions of migration.

For nearly twenty years the Biological Survey has been accumulating data on the migration of birds. Its own field naturalists, whose visits have extended over the North American Continent from Guatemala to the Arctic Circle, have furnished voluminous notes, besides which the assistance of ornithologists throughout the country has been enlisted, so that reports are received in the spring and fall of each year from hundreds of observers. These reports give, for each species, the date when the bird was first seen, when it became common, and when it disappeared. Light-house keepers also have supplied valuable information concerning the destruction of birds at their lights. The facts thus gathered from these various sources form the largest amount of material on bird migration ever collected in this country, and permit broader and safer generalizations than have heretofore been possible.

CAUSES OF MIGRATION.

For more than two thousand years the phenomena of bird migration have been noted; but while the extent and course of the routes traversed have of late become better known, no conclusive answer has been found to the question, why do birds migrate? Some dismiss the subject with the statement that fall migration is caused by failure of the food supply, spring migration by love of home. All are familiar with the rush of waterfowl northward so early that they are often forced by storms to retrace their flight; and all know that robins, bluebirds, and swallows, following closely in the rear, sometimes lose hundreds out of their flocks by cold and starvation. If strong home

love causes these birds thus to hazard their lives, why do they desert that home at the earliest possible moment; and if fall migration is caused by lack of food, why does it commence when food is most abundant? Data recently collected at the Florida light-houses by the Biological Survey show that southward migration begins at least by the 10th, and probably by the 1st of July, insect-eating birds departing when their food supplies are most plentiful, and seed eaters just before the heyday of harvest.

The broad statement can be made that the beginnings of migration ages ago were intimately connected with periodic changes in the food supply, but this motive is at present so intermingled with others unknown, or but imperfectly known, that migration movements seem now to bear little relation to the abundance or absence of food.

HOW DO BIRDS FIND THEIR WAY?

How do birds find their way over the hundreds or thousands of miles between the winter and summer homes? Among day migrants sight is probably the principal guide, and it is noticeable that these seldom make the long single flights so common with night migrants. Sight undoubtedly plays a part in guiding the night journeys also; on clear nights, especially when the moon shines brightly, migrating birds fly high, and the ear can scarcely distinguish their faint twitterings; if clouds overspread the heavens, the passing flocks sink their course nearer to the earth, and their notes are much more distinctly heard; and on very dark nights one may even hear the flutter of vibrant wings but a few feet overhead. So far as known, birds never intentionally migrate above the clouds, and when suddenly formed vapor cuts them off from sight of the earth, they lower their flight until the friendly landscape is again visible. Nevertheless, something besides sight guides these travelers in the upper air. In Alaska a few years ago members of the Biological Survey on the Harriman expedition went by steamer from the island of Unalaska to Bogoslof Island, a distance of about 60 miles. A dense fog had shut out every object beyond a hundred yards. When the steamer was halfway across, flocks of murres, returning to Bogoslof after long quests for food, began to break through the fog wall astern, fly parallel with the vessel, and disappear in the mists ahead. By chart and compass the ship was heading straight for the island; but its course was no more exact than that taken by the birds. The power which carried them unerringly home over the ocean wastes, whatever its nature, may be called a sense of direction. We recognize in ourselves the possession of some such sense, though imperfect and easily at fault. Doubtless a similar but vastly more acute sense enabled the murres, flying from home and circling wide over the water, to keep in mind the direction of their nests and return to them without the aid of sight. It is probable that this faculty is exercised during migration.

Reports from light-houses in southern Florida show that birds leave Cuba on cloudy nights when they can not possibly see the Florida shores, and safely reach their destination, provided no change occurs in the weather. But if meantime the wind changes or a storm arises to throw them out of their reckoning, they become bewildered, lose their way, and fly toward the light-house beacon. Unless killed by striking the lantern, they hover near or alight on the balcony, to continue their flight when morning breaks, or, the storm ceasing, a clear sky allows them once more to determine the proper course.

Birds flying over the Gulf of Mexico to Louisiana, even if they ascended to the height of 5 miles, would still be unable to see a third of the way across. Nevertheless this trip is successfully made twice each year by countless thousands of the warblers of the Mississippi Valley.

A favorite belief of many American ornithologists is that coast lines, mountain chains, and especially the courses of the larger rivers and their tributaries, form well-marked highways along which birds return to previous nesting sites. According to this theory, a bird breeding in northern Indiana would in its fall migration pass down its own little rivulet to the nearest creek, along this to the Wabash River, thence to the Ohio, and finally reaching the Mississippi, would follow its course to the Gulf of Mexico; and would use the same route reversed for the return trip in the spring. The fact is that each county in the Central States contains nesting birds, the different species of which at the beginning of the fall migration scatter toward half the points of the compass. Indeed, it would be safe to say "all the points of the compass," as some young herons preface their regular journey south with a little pleasure trip to the unexplored North.

In the fall thousands of birds reared in Indiana, Illinois, and northwestward visit South Carolina and Georgia, cutting directly across the valley of the Ohio and the main chain of the Allegheny Mountains. Palm warblers from New England and others from the northern Mississippi Valley both pass in the fall through Georgia, but by courses approximately at right angles to each other; and the Connecticut warbler seeks variety by choosing different routes for the spring and fall, each course in part being at right angles to the other. The truth seems to be that birds pay little attention to natural physical highways, except when large bodies of water force them to deviate from the desired course. Probably there are many short zigzags from one favored feeding spot to another, but the general course between the summer and winter homes is as straight as the birds can find without missing the usual stopping places.

CASUALTIES DURING MIGRATION.

Migration is a season full of peril for myriads of winged travelers, especially for those that cross large bodies of water. Some of the shore birds, such as the plover and curlew, which take long ocean

voyages, can rest on the waves if overtaken by storms, but woe to the luckless warbler whose feathers once become water-soaked!—a grave in the ocean or a burial in the sand of the beach is the inevitable result. Nor are such accidents infrequent. A few years ago on Lake Michigan a storm during spring migration piled many birds along the shore. If such a mortality could occur on a lake less than 100 miles wide, how much greater might it not be during a flight across the Gulf of Mexico. Such a catastrophe was once witnessed from the deck of a vessel 30 miles off the mouth of the Mississippi River. Large numbers of migrating birds, mostly warblers, had accomplished nine-tenths of their long flight and were nearing land when they were caught by a "norther" with which most of them were unable to contend, and falling into the Gulf were drowned by hundreds.

During migration, birds are peculiarly liable to destruction by striking high objects. A new tower in a city kills many before the survivors learn to avoid it. The Washington Monument has caused the death of many little migrants; and though the number of its victims has decreased of late years, yet on a single morning in the spring of 1902 nearly 150 lifeless bodies were strewn around its base.

Bright lights attract birds from great distances. While the torch in the Bartholdi Statue of Liberty in New York Harbor was kept lighted, the sacrifice of life it caused was enormous, even reaching a maximum of 700 birds in a month. A flashing light frightens birds away and a red light is avoided by them as if it were a danger signal, but a steady white light looming out of the mist or darkness seems to act like a magnet and draws the wanderers to destruction. Coming from any direction, they veer around to the leeward side, and then, flying against the wind, dash themselves against the pitiless glass.

DISTANCE OF MIGRATION.

The length of the migration journey varies enormously. Some birds do not migrate at all. Many a cardinal, Carolina wren, and bobwhite rounds out its whole contented life within 10 miles of its birthplace. Other birds, for instance, the pine warbler and the blackheaded grosbeak, do not venture in winter south of the breeding range, so that with them fall migration is only a withdrawal from the northern and a concentration in the southern part of the summer home—the warbler in about a fourth and the grosbeak in less than an eighth of the summer area.

The next variation is illustrated by the robin, which occurs as a species in the middle districts of the United States throughout the year, in Canada only in summer, and along the Gulf of Mexico only in winter. Probably no individual robin is a continuous resident in any section; but the robin that nests, let us say, in southern Missouri,

will spend the winter near the Gulf, while his hardy Canada-bred cousin will be the winter tenant of the abandoned summer home of the southern bird.

Most migrants entirely change their abode twice a year, and some of them travel immense distances. Of the land birds, the common eastern nighthawk seems to deserve first place among those whose winter homes are widely distant from their breeding grounds. Alaska and Patagonia, separated by 115 degrees of latitude, are the extremes of the summer and winter homes of the bird; and each spring many a nighthawk travels the 5,000 miles that lie between. But some of the shore birds are still more inveterate voyagers. These cover from 6,000 to 8,000 miles each way, and appear to make traveling their chief occupation.

ROUTES OF MIGRATION.

Birds often seem eccentric in choice of route, and many land birds do not take the shortest line. The fifty species from New England that winter in South America, instead of making the direct trip over the Atlantic, involving a flight of 2,000 miles, take a slightly longer route which follows the coast to Florida, and passes thence by island or mainland to South America. What would seem at first sight to be a natural and convenient migratory highway extends from Florida through the Bahamas or Cuba to Haiti, Porto Rico, and the Lesser Antilles, and thence to South America. The bird that travels by this route need never be out of sight of land; resting places may be had at convenient intervals, and the distance is but little longer than the water route. Yet, beyond Cuba, this highway is little used. About 25 species continue as far as Porto Rico and remain there through the winter. Only adventurers out of some 6 species gain the South American mainland by completing the island chain. The reason seems not far to seek—scarcity of food. The total area of all the West Indies east of Porto Rico is a little less than that of Rhode Island. Should a small proportion only of the feathered inhabitants of the eastern part of the United States select this route, not even the luxuriant fauna and flora of the Tropics could supply their needs.

A still more direct route, but one requiring longer single flights, stretches from Florida to South America via Cuba and Jamaica. The 150 miles between Florida and Cuba are crossed by tens of thousands of birds of some 60 different species. About half the species take the next flight of 90 miles to the beautiful Jamaican mountains. Here a 500-mile stretch of islandless ocean confronts them, and scarcely a third of their number leave the forest-clad hills for the unseen beyond. Chief among these dauntless voyagers is the bobolink, fresh from despoiling the Carolina rice fields, waxed fat from his gormandizing, and so surcharged with energy that the 500-mile flight to South America on the way to the waving pampas of southern Brazil seems a small hardship.

Indeed, many bobolinks appear to scorn the Jamaican resting point and to compass in a single flight the 700 miles from Cuba to South America. With the bobolink is an incongruous company of traveling companions—a vireo, a king bird, and a nighthawk that summer in Florida; the queer chuck-will's-widow of the Gulf States; the two New England cuckoos; the trim Alice thrush from Quebec; the cosmopolitan bank swallow from frozen Labrador, and the black-poll warbler from far-off Alaska. But the bobolinks so far outnumber all the rest of the motley crew that the passage across the Caribbean Sea from Cuba to South America may with propriety be called the "bobolink route." Occasionally a mellow-voiced wood thrush joins the assemblage, or a green-gold tanager which will prepare in the winter home its next summer livery of flaming scarlet. But the "bobolink route" as a whole is not popular with other birds, and the many that traverse it are but a fraction of the thousands of North American birds that spend the winter holiday in South America.

The main traveled highway is that which stretches from northwestern Florida across the Gulf, continuing the southwest direction which most of the birds of the Atlantic coast follow in passing to Florida. A larger or smaller proportion of nearly all the species bound for South America take this roundabout course, quite regardless of the 700-mile flight over the Gulf of Mexico. It might seem more natural for the birds to make a leisurely trip along the Florida coast, take a short flight to Cuba, and thence a still shorter one of less than 100 miles to Yucatan—a route only a little longer and with much less of exposure. Indeed, the earlier naturalists, finding the same species both in Florida and in Yucatan, took this probable route for granted, and for years it has been noted in ornithological literature as one of the principal migration highways of North American birds. As a fact, it is almost deserted except by a few swallows, some shore birds, and an occasional land bird storm-driven from its intended course, while over the Gulf route, night after night, for nearly eight months in the year, myriads of hardy migrants wing their way through the darkness toward an unseen destination.

West of the Florida route the Gulf is crossed by migrating birds at its widest point, from Louisiana southward. Still farther west, the numerous species of Plains and Rocky Mountains birds choose Mexico and Central America for the winter, and make a land journey of short stages that extends over several weeks.

As already stated, the longest migration route is taken by some of the wading birds, especially the American golden plover, the Eskimo curlew, and the turnstone. The journey of the plover, which is typical, is wonderful enough to be given in detail. In the first week of June they arrive at their breeding grounds in the bleak, wind-swept "barren grounds" above the Arctic Circle, far beyond the tree line. Some even venture 1,000 miles farther north (Greely found them at

latitude 81°). While the lakes are still icebound, they hurriedly fashion shabby little nests in the moss only a few inches above the frozen ground. By August they have hastened to Labrador, where, in company with curlews and turnstones, they enjoy a feast. Growing over the rocks and treeless slopes of this inhospitable coast is a kind of heather, the crowberry, bearing in profusion a juicy black fruit. The extravagant fondness shown for the berry by the birds, among which the curlew, owing to its greater numbers, is most conspicuous, causes it to be known by the natives as the "curlew berry." The whole body of the curlew becomes so saturated with the dark purple juice that birds whose flesh was still stained with the color have been shot 1,000 miles south of Labrador.

After a few weeks of such feasting, the plovers become excessively fat and ready for their great flight. They have reared their young under the midnight sun, and now they seek the Southern Hemisphere. After gaining the coast of Nova Scotia they strike straight out to sea, and take a direct course for the easternmost islands of the West Indies. Eighteen hundred miles of ocean waste lie between the last land of Nova Scotia and the first of the Antilles, and yet 600 more to the eastern mainland of South America, their objective point. The only land along the route is the Bermuda Islands, 800 miles from Nova Scotia. In fair weather the birds fly past the Bermudas without stopping; indeed, they are often seen by vessels 400 miles or more east of these islands. When they sight the first land of the Antilles the flocks often do not pause, but keep on to the larger islands and sometimes even to the mainland of South America. Sometimes a storm drives them off the main track, when they seek the nearest land, appearing not infrequently at Cape Cod and Long Island.

A few short stops may be made in the main flight, for the plover swims lightly and easily and has been seen resting on the surface of the ocean; and shore birds have been found busily feeding 500 miles south of Bermuda and 1,000 miles east of Florida, in the Atlantic, in that area known as the Sargasso Sea, where thousands of square miles of seaweed teem with marine life.

Though feathered balls of fat when they leave Labrador and still plump when they pass the Bermudas, the plovers alight lean and hungry in the Antilles. Only the first, though the hardest, half of the journey is over. How many days it has occupied may never be known. Most migrants either fly at night and rest in the day or vice versa, but the plover flies both night and day.

After a short stop of three or four weeks in the Antilles and on the northeastern coast of South America, the flocks disappear, and later their arrival is noted at the same time in southern Brazil and the whole prairie region of Argentina almost to Patagonia. Here they remain from September to March (the summer of the Southern Hemisphere), free from the responsibilities of the Northern summer they have left.

The native birds of Argentina are at the time engrossed in family cares; but no wayfarer from the north nests in the south.

After a six-months' vacation the plovers resume the serious affairs of life and start back toward the Arctic, but not by the same course. Their full northward route is a problem still unsolved. They disappear from Argentina and shun the whole Atlantic coast from Brazil to Labrador. In March they appear in Guatemala and Texas; April finds their long lines trailing across the prairies of the Mississippi Valley; the first of May sees them crossing our northern boundary; and by the first week in June they reappear at their breeding grounds in the frozen North. What a journey! Eight thousand miles of latitude separates the extremes of their elliptical course, and 3,000 miles of longitude constitutes the shorter diameter, and all for the sake of spending ten weeks on an Arctic coast! (See fig. 44.)

ARE BIRDS EXHAUSTED BY A LONG FLIGHT?

During the spring migration of 1903 two skilled ornithologists spent the entire season near the coast of northwestern Florida, visiting every sort of bird haunt. They were eminently successful in the long list of species identified, but their enumeration is still more remarkable for what it does not contain. About twenty-five species of the smaller land birds of the eastern part of the United States, including a dozen common species, were not seen. Among these were the chat, the redstart, and the indigo bunting, three species that are abundant throughout the whole region to the northward. The explanation of this seems to be that these birds, on crossing the Gulf of Mexico, flew far inland before alighting, and thus passed over the observers. It would thus seem that the popular idea that birds find the ocean flight excessively wearisome, and that after laboring with tired pinions across the seemingly endless wastes they sink exhausted on reaching terra firma, is not in accordance with the facts. The truth seems to lie in almost the opposite direction. Endowed by nature with wonderful powers of aerial locomotion, under normal conditions many birds not only cross the Gulf of Mexico at its widest point, but may even pass without pause over the low, swampy coastal plain to the higher territory beyond. So little averse are birds to an ocean voyage that many fly from eastern Texas to the coast of southern Mexico, though this 400 miles of water journey hardly shortens the distance of travel by an hour's flight. Thus, the birds avoid the hot, treeless plains and scant provender of southern Texas by a direct flight from the moist, insect-teeming forests of northern Texas to similar country in southern Mexico. Under favorable conditions, birds can fly practically where, when, and how they please; consequently their choice of route and the distance covered at a single flight are principally governed by the food supply.

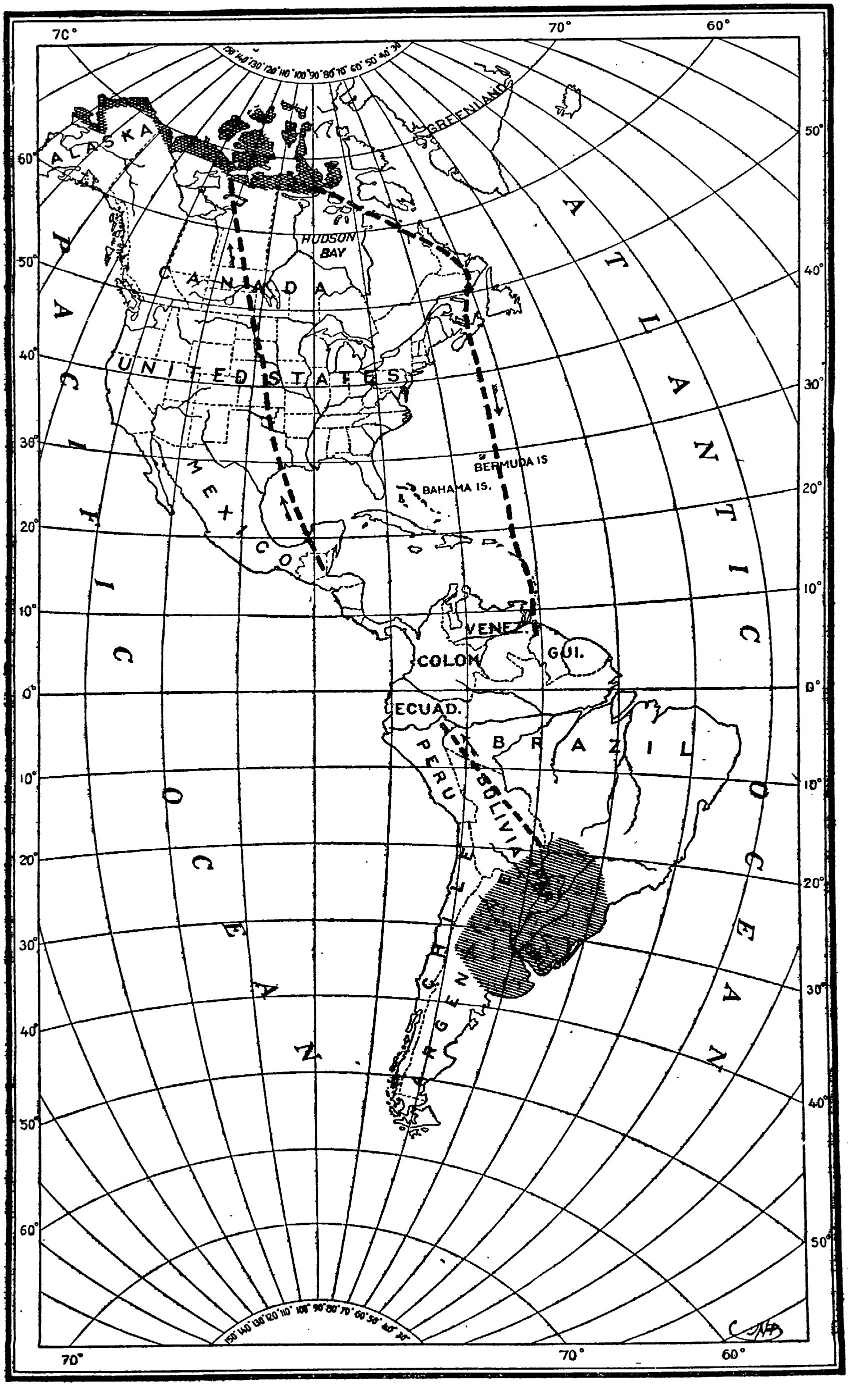

FIG. 44.—Route of migration of the Golden Plover (*Charadrius dominicus*): Breeding range ; winter home ; and approximate main lines of migration so far as determined.

RELATIVE POSITION DURING MIGRATION.

The relative position of the northern and southern groups of individuals of a species during the two yearly migrations is one of the doubtful points that late investigations help to elucidate. The supposition is that in the case of species which adopt what might be called normal fall migration, birds which nest farthest south migrate first and proceed to the southern end of the winter range; those that breed in the middle districts migrate next and occupy the middle of the winter range; and finally, those of the northern part of the breeding range migrate last, and remain the farthest north for the winter. In other words, the migration is a synchronous southward movement of the whole species, the different groups of individuals or colonies retaining in general their relative positions. This has been generally believed, but only of late has it been clearly proved as to any particular species.

An example or two will make this clear. The black and white creeper breeds from South Carolina to New Brunswick. In the southern part of its range it nests in April. New Brunswick, however, is scarcely reached by the earliest birds before the middle of May, as the species occupies about fifty days in crossing the breeding range. If sixty days are considered the shortest possible time in which such a bird can build a nest, rear the young, molt, and be ready for the return journey, then no New Brunswick black and white creeper is ready to start south before the middle of July, and fifty days for the trip will bring the earliest migrants to the Gulf States in September. Yet both old birds and young of the year have been seen by the middle of July at Key West, Fla., 500 miles south of the breeding range, on August 10 in Costa Rica, and on August 21 on the northern coast of South America. These dates prove conclusively that these early migrants south of the United States could not have been birds from the northern part of the range, but must have been those of the southern part.

Black-throated blue warblers reach Cuba in the fall at just about the time that other migrants of the species appear in North Carolina. The inference is that the arrivals in Cuba are the birds that nested in the southern Alleghenies, while those appearing in North Carolina are from the latitude of northern New England or beyond. Redstarts and summer warblers arrive on the northern coast of South America so early (August 27 to September 2) as to prove that they represent the southern breeding birds. Indeed, these representatives of the species are seen in South America at just about the time the earliest of the northern breeding birds reach Florida.

Recent investigations have also shown that many species of birds do not follow this "normal" order of migration. The most southern-bred Maryland yellow-throats are almost nonmigratory, residing

throughout the year in Florida; those breeding in the middle districts migrate only a short distance, while those of Newfoundland go to the West Indies, passing directly over the winter home of their fellows in the South. The red-winged blackbirds of the middle of the range in northern Texas are almost stationary, but are joined in winter by migrant redwings from the remote Mackenzie Valley. The palm warblers of the interior of Canada, in the course of their 3,000-mile journey from Great Slave Lake to Cuba, pass through the Gulf States early in October. After the bulk of these have passed, the palm warblers of the northeastern British provinces come slowly down to the Gulf States, and settle there for the winter, content with only a 1,500-mile trip. Some of the blackpoll warblers that pass in spring through Florida proceed northeast 1,000 miles to breed in northern New England, while others, traveling northwest more than 3,000 miles summer in Alaska. Among the Maryland yellow-throats that nest in western Pennsylvania are undoubtedly individuals that during the winter are scattered in the Gulf States, the West Indies, and even Central America. Enough examples have been given to show that no invariable rule, law, or custom exists in regard to the direction or distance of migration. The winter distribution can not be certainly determined from the summer home, nor does it positively indicate that home. Although a certain general tendency is observable, yet each species presents a separate problem, to be solved for the most part only by patient, painstaking observation and by the recognition of subspecies.

Spring migration has its own special features. No such synchronous movement occurs in the spring as has been described as "normal migration" in the fall. With many birds, possibly the majority of land birds, the first individuals of a species to appear in spring at a given locality are supposed to be old birds that nested there the previous year. The supposition is that these birds are followed by those that nested in the region just to the north; and that later, those of still more northern homes pass by; and that the last to appear will be those whose homes are in the most northern part of the breeding range. If, then, for any species, the southern nesting birds lead the van in both fall and spring migration, and the rear guard in each case is composed of northern breeding birds, it follows that some time between October and April a transposal of their relative positions occurs; and that the more southern birds pass over the more northern ones, which delay their migration, knowing that winter still holds sway in their summer dominions. Just when and where this transposal of relative position occurs is one of the problems of migration reserved for future solution. Nor is it yet settled whether the northern-bred birds remain strictly within their winter range until after their more southern congeners have passed by, or whether they begin an early

migration at so slow a speed as soon to be overtaken and passed by their impetuous cousins.

Still later in the spring another transposal occurs. The northern birds pass across the southern portion of the breeding range, where the southernmost birds are already busy with their domestic duties. Spring migration seems to be therefore for some species a game of leapfrog—the southern birds first passing the northern, and the northern passing them in turn.

RELATION OF MIGRATION AND TEMPERATURE.

A popular notion exists that birds push northward to their summer homes as soon as weather conditions permit. This may be true of a few species, but certainly birds in general have no such habit. Some summer warblers that return to the Great Slave Lake region to breed, after spending the winter in Central and South America, arrive at their nesting grounds when the average daily temperature is about 47° F. According to the notion mentioned, these birds might be expected to move up the Mississippi Valley and on to their summer homes at the same time as the northward-moving temperature of 47° F. But were this so, they would never leave the United States, for the average of the coldest month of the year at New Orleans is 54° F. As a matter of fact, the summer warblers of Great Slave Lake are probably too well content with the warm, humid, insect-laden air of the South to brave the arctic blasts before necessity compels. They linger in the Tropics so late that when they reach New Orleans, April 5, an average temperature of 65° F. awaits them. They now hasten; traveling north much faster than the spring does, they cover 1,000 miles in a month, and find in southern Minnesota a temperature of 55° F. In central Manitoba the average temperature they meet is 52° F., and when they arrive late in May at Great Slave Lake they have gained 5° more on the season. Thus, during the whole trip of 2,500 miles from New Orleans to Great Slave Lake, these birds are continually meeting colder weather. In fact, so fast do they migrate that in the fifteen days from May 11 to 25 they traverse a district that spring requires thirty-five days to cross. This outstripping of spring is habitual with all species that leave the United States for the winter, and also with most of the northern birds that winter in the Gulf States. Careful examination of the migration records of each species of the Mississippi Valley shows only six exceptions—Canada goose, mallard, pintail, common crow, red-winged blackbird, and robin.

The robin as a species migrates north more slowly than the opening of the season; it occupies seventy-eight days for its trip of 3,000 miles from Iowa to Alaska, while spring covers the distance in sixty-eight days. But it does not follow that any individual bird moves northward at this leisurely pace. The first robins that reach a given locality in the spring are likely to remain there to nest, and the advance of the

migration line must await the arrival of other birds from still farther south. Therefore, each robin undoubtedly migrates at a faster rate than the apparent movement of his species as a whole, and does not fall behind the advancing season. This is true of most, if not all, of the other seemingly slow migrants. Late and rapid journeys of this kind offer certain advantages; fewer storms are encountered, the mortality rate is lowered, food is more plentiful along the way, and the birds reach the nesting site full of energy, bubbling over with song, and in good condition to assume the cares and labors of house building and brood raising.

VARIATIONS IN THE SPEED OF MIGRATION.

The immense variation in the speed with which migrants travel different parts of the broad bird highway that extends from Gulf to Arctic Ocean, by way of the Mississippi and Mackenzie valleys, is a recently ascertained fact of special interest. The black-poll warbler furnishes one of the best examples of this. It winters in north central South America and migrates in April across the West Indies to Florida. From here some individuals pass on northwest to the Mississippi Valley, thence north to Manitoba, thence northwest to the valley of the Mackenzie, and thence almost due west to western Alaska. From the Gulf of Mexico to Minnesota a fairly uniform average speed of 30 to 35 miles per day is maintained; southern Indiana and Missouri are reached the first week in May, southern Iowa early in the second week, and southern Minnesota is entered by the middle of the month. Then comes a "spurt;" within another week the black-polls appear in the central part of the Mackenzie Valley, and the following week they arrive in northwestern Alaska, many individuals undoubtedly averaging more than 200 miles per day during the latter part of the journey. Thirty days are thus occupied in traveling the 1,000 miles from the Gulf of Mexico *north* to southern Minnesota, and scarcely half that time in traversing the 2,500 miles thence *northwest* to Alaska. The direction of migration is emphasized because this change of direction is intimately connected with the great increase of speed, as will be shortly explained.

A similar increase of speed is shown by many other species. The average speed of migration from New Orleans to southern Minnesota for all species is close to 23 miles per day. Sixteen species maintain a daily average of 40 miles from southern Minnesota to southern Manitoba, and from this point 12 species travel to Lake Athabasca at an average speed of 72 miles a day, 5 others to Great Slave Lake at 116 miles a day, and 5 more to Alaska at 150 miles a day.

The reason for these remarkable differences is not far to seek. The speed increases as the birds move northward because the advance of the seasons is more rapid in the northern interior than on and near the

southern coast. The farther removed a district is from the ocean, the greater the extremes of its temperature. At New Orleans, La., the average daily temperature of January is 54° F., and that of July is 82° F., while at Winnipeg, Manitoba, the corresponding average temperatures are: January, —7° F.; July, 66° F. Hence, while the temperature at New Orleans is rising 28 degrees, that at Winnipeg rises 73 degrees. Consequently, any given isotherm, as it moves north during the spring in the Mississippi Valley, continually increases the speed of its advance. The isotherm of 35° F., corresponding to the commencement of spring migration, advances north at the rate of 3 miles per day from January 15 to February 15, 10 miles daily during the next month, and 20 miles daily during the following month. (See fig. 45.)

But an additional explanation must be sought for the wonderfully quickened speed with which the birds pass northwestward from Minnesota to the Mackenzie Valley. Along the eastern foothills of the Rocky Mountains isotherms travel north faster than at corresponding latitudes farther east. From February 15 to March 15 the isotherm of 35° F. (the line of spring) passes along the foothills from New Mexico to northern Colorado at the rate of 12 miles per day. During the next month, under the influence of the chinook winds, its rate of northward progress is increased to 40 miles a day, so that by April 15 it has reached Lake Athabasca. Spring has come with a rush on this western interior country. The result is that during the height of the migration season, from the middle of April to the middle of June, the southern end of the Mackenzie Valley in the Province of Athabasca has just about the same temperature as the Lake Superior region 700 miles farther south.

These conditions, coupled with the diagonal course of the birds across this region of fast-moving spring, necessarily exert a powerful influence on bird migration. On March 1 the earliest robins reach southern Iowa, where they find an average daily temperature of about 34° F.; a month later they appear in central Minnesota and find the same temperature, birds and spring each having gone northward at the rate of 13 miles per day. Those robins that fly from eastern Minnesota and western Wisconsin to Lake Superior and Keewatin, by increasing their speed to 21 miles per day, arrive on April 21 at latitude 52° in southern Keewatin, still closely following the temperature of 34°. But by this date the 34° F. isotherm has reached central Athabasca, and the central Minnesota robins that travel to the Mackenzie Valley and Alaska must double and quadruple their speed as they take a northwestward diagonal, if they are to keep up with the season. Though robin migration does not quite do this, yet a speed of 70 miles per day is reached by the species in this northwestward flight—more than three times the speed attained by the Keewatin birds. (See fig. 45.)

THE UNKNOWN.

Interest in bird migration goes back to a remote period. Marvelous tales of the spring and fall movements of birds were spun by early

FIG. 45.—Speed of the Robin in migration.

Average position of the isotherm of 35° F. at the several dates mentioned.

Approximate migration route of the Robins of northwestern Alaska.

The dates represent the average time of arrival of the earliest Robins.

The numbers at the side of the migration route indicate in miles per day the average speed of migration between the dated places.

observers, yet hardly less incredible are the ascertained facts. Much remains to be learned of migration; and it may be of interest to note a few of the mysteries which still occupy attention.

The chimney swift is one of the most abundant and best-known birds of the eastern part of the United States. With troops of fledglings, catching their winged prey as they go, and lodging by night in some tall chimney, the flocks drift slowly south, joining with other bands until on the northern coast of the Gulf of Mexico they become an innumerable host. Then they disappear. Did they drop into the water and hibernate in the mud, as was believed of old, their obliteration could not be more complete. In the last week in March a joyful twittering far overhead announces their return to the Gulf coast, but the intervening five months is still the swift's secret.

The mouse-colored bank swallows are almost cosmopolitan, and enliven even the shores of the Arctic Ocean with their graceful aerial evolutions. Those that nest in Labrador allow a scant two months for building a home and raising a brood, and by the first of August are headed southward. Six weeks later they are swarming in the vicinity of Chesapeake Bay, and then they, too, pass out of the range of our knowledge. In April they appear in northern South America, moving north, but not a hint do they give of how they came there. The rest of the species, those that nest to the south or west, may be traced farther south, but they, too, fail to give any clew as to where they spend the five winter months.

The familiar cliff swallow, which swarms over the western plains and breeds from Mexico to Alaska, spends the winter in Brazil and Argentina. It would be expected to reach the United States in spring first in southern Florida and Texas, later in the Rocky Mountains, and finally on the Pacific coast. As a matter of fact, the earliest records of the bird's appearance in spring come from northern central California, where it becomes common before the first arrivals are usually noted in Texas or Florida. The route the species takes from Brazil to California is one of the yet unsolved migration puzzles.

The red-eyed vireo, the commonest and best known of its tuneful family, winters in Central America, from Guatemala to Panama. The advent of the species in spring at the mouth of the Mississippi and its even-paced passage at 20 miles per day for six weeks to the headwaters of the river are well attested by numerous records. But just about the time northern Nebraska is reached, and before they have appeared in any of the intervening country, red-eyed vireos are noted in southern British Columbia, 1,000 miles to the northwest. Is the presence of the red eye in British Columbia to be explained by the theory that it suddenly flies 1,000 miles in a single night?

It is such problems as these that continually vex and fascinate the investigator.

PRINCIPAL COMMERCIAL PLANT FIBERS.

By Lyster H. Dewey,

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Introduction.

One of the most important manufacturing industries of this country is that which includes the various lines of textiles. Leaving out the silk and woolen mills, which use chiefly animal fibers, there are the cotton factories, the linen and jute mills, and the twine and cordage mills, which use plant fibers exclusively. These number about 1,200 distinct establishments, representing an invested capital of more than $500,000,000 and giving productive employment to more than 300,000 persons.

The source of the raw material required by this great industry is an item of no small interest. Most of the cotton is produced in our Southern States, but nearly all the other vegetable fibers are imported. The importations of raw fibers, including cotton, during the fiscal year ended June 30, 1903, amounted to $46,161,172. These figures cover only the raw fiber. The importations of all the different kinds of textile plant fibers in the various stages of manufacture, from yarn and coarse twine to fine woven goods, laces, and hosiery, amount annually to more than $80,000,000.

Classification of Fibers.

Vegetable fibers used in textile manufactures in this country may be readily divided into three rather distinct classes, either from the standpoint of the manufacturer, who regards the kind of machinery or process of treating the fiber and the character of the goods produced, or from the viewpoint of the botanist, who regards the character of the plant and the manner in which the fiber is borne. These three classes are:

(1) The cottons, with soft, lint-like fiber ½ inch to 2 inches long, composed of single cells, borne on the seeds of different species of cotton plants.

(2) The soft fibers, or bast fibers, including flax, hemp, and jute; flexible fibers of soft texture, 10 to 100 inches in length, composed of many overlapping cells, and borne in the inner bark of the plants. (Pl. XLV, fig. 1.)

(3) The hard, or leaf, fibers, including manila, sisal, mauritius, New Zealand fibers, and istle, all having rather stiff, woody fibers 1 to 10 feet long, composed of numerous cells in bundles, borne in the tissues of the leaf or leaf stem. (Pl. XLV, fig. 2.)

COTTONS.

Cotton easily outranks both of the other classes combined in the quantity used, the capital invested in its production and manufacture, and the diversity of its uses. It is produced at a comparatively small cost, is spun into yarn with greater ease and rapidity than any other vegetable fiber, and is readily adapted to nearly all forms of woven fabrics. These facts have led to its extensive use among all civilized nations.

AMERICAN UPLAND COTTON.

Among the half dozen rather distinct types of cottons recognized by producers and manufacturers the most extensively used is the American Upland (Pl. XLVI, fig. 1). This is cultivated in the Southern States from Virginia to Oklahoma and Texas. It has given such good results here that seed has been taken to all other cotton-growing regions, and now American Upland cotton is cultivated in Russian Turkestan, Persia, India, British and German West Africa, Brazil, and Porto Rico.

There are more than a hundred recognized horticultural varieties of Upland cotton in cultivation, all belonging to one botanical species, *Gossypium hirsutum*, native in the American tropics. The original wild plants in the tropical zone were perennials, but the plant is cultivated as an annual. The seed is sown in the spring, in drills, rarely in checks, and cultivated in the same manner as corn. The lint, or cotton of commerce, is borne on fuzzy seeds in seed pods ("bolls"—Pl. XLV, fig. 3) which burst open at maturity (September to November in the Southern States), exposing the fluffy wool-covered seed clusters ready for picking. The lint is separated from the seeds by ginning and packed in bales for shipment.

The average annual production of Upland cotton in the Southern States during the past five years has ranged between 9,500,000 and 11,000,000 bales of 500 pounds each. The prices during this period have varied from 6 to 16 cents per pound. The value of the crop, more than $500,000,000, exceeds that of any other crop, except corn, produced in this country.

The lint of Upland cotton consists of fibers one-half inch to 1½ inches in length, white, appearing when highly magnified like flattened tubes or collapsed fire hose, spirally twisted. This twist enables the fibers to cling together, making a strong thread when spun; furthermore, it permits them to bend without breaking, enabling them to be spun into a hard-twisted, yet flexible, yarn or thread.

Upland cotton is spun into yarn, and the yarn is twisted into sewing thread, wrapping twine, or small sizes of rope, is braided into cord, knit into hosiery, or woven into cloth, ranging from the standard unbleached factory goods to fancy velveteens and novelties in colors. Raw cotton is also mixed with wool, and cotton yarn often appears as a mixture in woolen, silk, and linen goods.

SEA ISLAND COTTON.

Sea Island cotton is obtained from a plant known technically as *Gossypium barbadense* (Pl. XLVI, fig. 2). This species was found in the West Indies when Columbus first visited those islands. The best varieties of Sea Island cotton have been developed by careful seed selection and cultivation on James and Edisto islands, along the coast of South Carolina. This cotton is cultivated on other islands and the adjacent mainland in that region, and also in sandy soils in the interior, across southern Georgia and northern Florida. Fresh supplies of seed are brought from the coast every two or three years to keep up the quality of that grown in the interior. During the last two years the cultivation of Sea Island cotton has been reintroduced into Porto Rico and the British West Indies, and under improved conditions it seems likely to become more profitable there than before it was crowded out by the sugar industry.

The Sea Island plant differs from that of Upland cotton in its larger growth—3 to 8 feet high, with longer and more flexible branches, more deeply lobed leaves, bright yellow flowers, and sharp-pointed bolls, having three instead of four or five divisions or locks (Pl. XLV, fig. 3). The seeds are black or dark brown, and are not covered with a persistent fuzz. The lint is $1\frac{5}{8}$ to 2 inches long, finer and longer than that of Upland cotton, and usually softer and more lustrous. It commands a price ranging from 2 to 15 cents per pound more than Upland cotton, but it requires greater care in its production and is more exacting in regard to soil and climate. It yields less per acre (100 to 300 pounds), and costs more to pick and to gin. It is used in making fine threads for sewing and for laces, fine yarns for fancy hosiery, for weaving into the finest lawns and dimities, and generally for the most expensive grades of cotton goods.

An important derivative of Sea Island cotton is that known as long-staple Upland, obtained by careful selection from hybrids of Sea Island and Upland cotton. The long-staple Upland cottons are cultivated chiefly in the rich alluvial soil of the Yazoo delta in Mississippi. The lint is intermediate in character between Sea Island and Upland cotton.

EGYPTIAN COTTON.

Another still more important derivative of the Sea Island type is Egyptian cotton, cultivated on the irrigated lands of Egypt, where

scarcely any rain falls from the time the seed is planted in March until the last of the crop is picked in November. Many generations of growth under these conditions, and possibly some hybridization with India cotton, have developed a peculiar quality of lint especially adapted to the manufacture of hosiery yarns and mercerized goods. The United States imports Egyptian cotton to the value of $7,000,000 to $10,000,000 each year, and the demand is steadily growing, owing to the increasing use of knit goods and the continued popularity of the silk-like mercerized cotton goods.

INDIA COTTON.

The cotton of East India, next in importance, is obtained chiefly from a species of plants native in southern Asia, *Gossypium herbaceu* (Pl. XLVI, fig. 3). The plants differ from American Upland cotton in their more slender, less woody stems, with leaves having roundish instead of sharp-pointed lobes, and in the smaller, more nearly spherical bolls (Pl. XLV, fig. 3). The lint of some varieties is glossy white, of others dull, of some yellow, and of still others golden brown. It is generally coarser and shorter than American Upland cotton, ranging from one-half to an inch in length. Outside of India it is used chiefly for medium or coarse yarns and for mixing with other cotton. Very little of it is imported into this country. It is cultivated in Farther India, China, Bengal, Persia, Arabia, and the Levant.

PERUVIAN COTTON.

In South America, Peruvian cotton (*Gossypium peruvianum*) is cultivated chiefly in Brazil and Peru. This cotton, often called kidney cotton, is characterized by the seeds in each lobe of the capsule clinging together in a compact cluster. These seeds are black and without a persistent fuzzy covering. The lint shows a wide variation in color and texture—white, brown, reddish, rough and harsh, or smooth and soft. Most of it has a shorter, coarser, and more wiry fiber than that of American Upland. The lint of some varieties is much like wool in appearance. It is imported chiefly for mixing with wool or for producing special effects. Kidney cotton is found in Central America and also in the Philippines and other tropical islands of the Pacific, but it is not cultivated in commercial quantities outside of South America.

SOFT FIBERS.

FLAX.

The flax plant (*Linum usitatissimum*—Pl. XLVII, fig. 1) originated in western Asia in the region between the Caspian Sea and the Persian Gulf. It was doubtless one of the earliest plants cultivated for fiber, and from the times of the first authentic record until the advent of

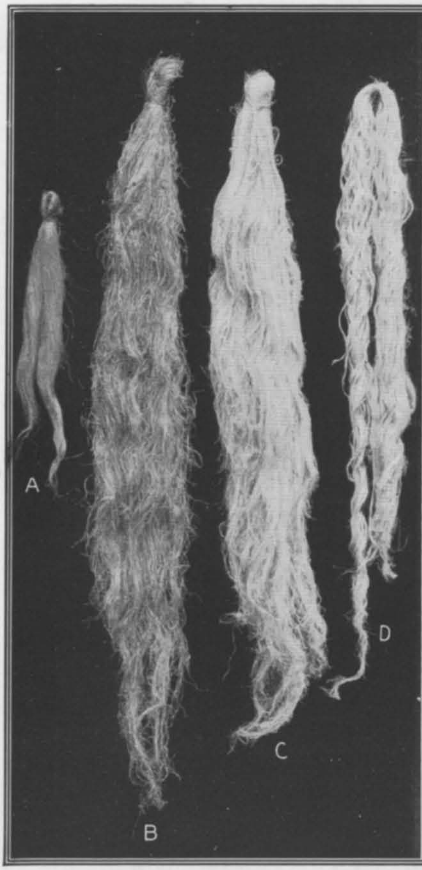

FIG. 1.—SOFT FIBERS.

[*A*, Flax; *B*, Hemp, dew-retted; *C*, Hemp, water-retted; *D*, Jute.]

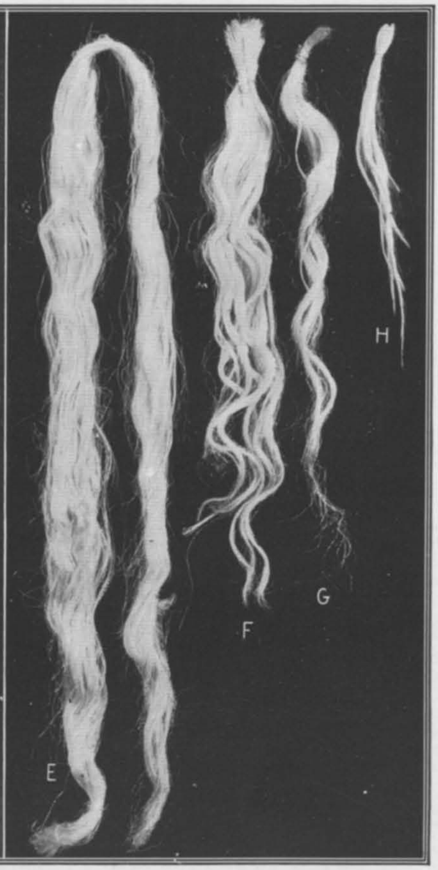

FIG. 2.—HARD FIBERS.

[*E*, Manila; *F*, Sisal; *G*, Mauritius; *H*, Istle.]

American Upland. Sea Island. India.

FIG. 3.—COTTON BOLLS.

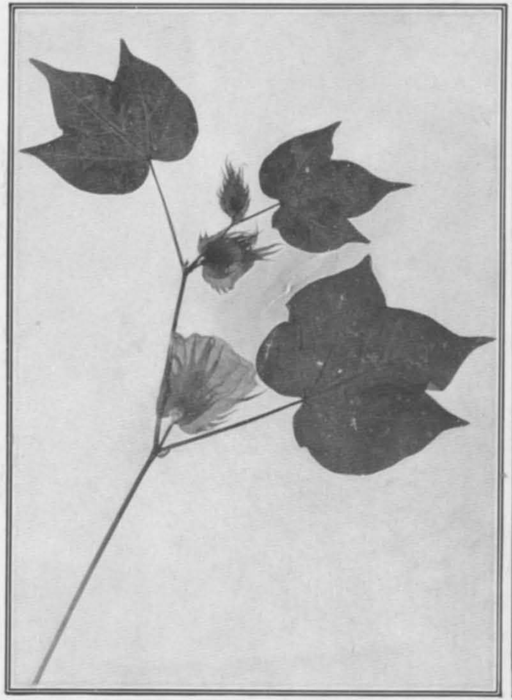

FIG. 1.—AMERICAN UPLAND COTTON (GOSSYPIUM HIRSUTUM).

FIG. 2.—SEA ISLAND COTTON (GOSSYPIUM BARBADENSE).

FIG. 3.—INDIA COTTON (GOSSYPIUM HERBACEUM).

cheaper cotton during the last century, it was used more extensively than any other vegetable fiber. In central and northern Russia, and in Holland, Belgium, Ireland, and northern Italy flax is still cultivated primarily for the production of fiber. In southern Russia, British India, Argentina, and the United States it is cultivated almost exclusively for seed production. In these regions the straw is burned, used for stable bedding, or sometimes for forage where there is a scarcity of hay. A small portion of the flax straw produced in North Dakota is used for paper stock, and in a few localities in the Dakotas, Minnesota, and Ohio it is made into upholstering tow. Only in the vicinity of Yale in eastern Michigan, at Northfield and Heron Lake, Minn., and at Salem and Scio, Oreg., is flax cultivated in this country for the production of spinning fiber. In all these localities the seed is saved, and it is doubtful if the industry would yield sufficient profits from the production of fiber alone to warrant its continuance under present conditions. All of the fiber flax of this country, as well as that of Ireland, Belgium, and Holland, is grown from seed of Russian origin. The plants deteriorate when grown from seeds of the third or fourth generation in this country, and unless special attention is given to selection and the production of improved strains it is necessary to import a new stock every three or four years.

Flax is a rather dainty surface feeder, with a small root system, yet it must make a rapid growth, reaching maturity in about one hundred days. It requires a soil with a sufficient amount of fertilizing elements readily available. It is apparently of still greater importance that the soil be continually moist during the growing season, and for the production of the best quality of fiber a moist atmosphere is essential. Carefully conducted experiments, as well as the observations of practical flax growers, have proved conclusively that this crop does not draw on the fertility of the soil as much as wheat, oats, or barley. It can not be cultivated year after year on the same land, because of a disease,[a] flax-wilt, the spores of which remain in the soil, infecting future crops. Since this disease does not attack other ordinary crops, flax may be introduced in a rotation, preferably after grass or pasture, once in six or eight years.

Flax is sown early in the spring, broadcast, like oats or wheat, either by hand seeder or with a drill. The seed should be covered evenly, and to a depth not exceeding an inch—one-half inch is better. No further attention is required until the crop is harvested late in July or early in August. The best flax is pulled, for the following reasons: (1) To secure straw of full length; (2) to avoid stain and injury which would result from soil moisture soaking into the cut stems while curing in the shock; (3) to secure better curing of the straw and ripening of the seed;

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[a] Bolley. Bulletin No. 50, North Dakota Experiment Station.

and, (4) to avoid the blunt cut ends of the fiber. Flax that has not grown well enough to produce first-grade fiber is sometimes cut with a self-rake reaper. After curing in the shock for two or three weeks the seed is thrashed out, usually by holding an unbound bundle in the hands and passing the heads two or three times between rapidly revolving rollers which crush the seed pods, the seed afterwards being cleaned in a fanning mill. The straw is then bound into bundles and stored until time for retting, in October or early November. Nearly all of the fiber flax grown in the United States and Canada is retted by spreading the straw carefully and evenly on the ground, where it is exposed to the weather for two to four weeks. After retting, it is raked up, tied in bundles, and taken to the mills, where it is broken, scutched, and hackled. In each of these operations it is picked up and handled in small handfuls, and some of the processes, especially hackling, require a high degree of skill. Numerous machines have been invented to pull flax, spread it for retting, break it, and scutch the fiber, but none of them has given sufficient satisfaction to be generally adopted. Until machines are devised to take the place of hand labor and reduce the cost of the preparation of flax fiber there is little probability that the industry in this country can be increased in competition with other crops which may be cultivated with greater profit.

The importations of flax fiber amount to about $2,000,000 annually. Most of this comes from Russia, Belgium, and Holland. In Belgium and Holland the flax is retted by soaking in water, which produces a whiter, softer fiber, but the process is more laborious and expensive than the dew retting practiced in this country.

Flax fiber is from 12 to 36 inches in length, silvery gray when dew retted, yellowish white when water retted, capable of fine subdivision, soft and flexible, and is the strongest of the fine commercial bast fibers. It is used for making linen sewing thread, shoe thread, bookbinders' thread, fishing lines, seine twine, the better grades of wrapping twine and knit underwear, and for weaving into handkerchiefs, toweling, table linen, collars and cuffs, shirt bosoms, and dress goods. The finer grades of linen damasks are imported, as the weaving of these goods is slow work, and requires a kind of labor not commonly found in this country.

HEMP.

Hemp (Pl. XLVII, fig. 2) originated in western Asia. Like flax, it was cultivated for fiber several centuries before the Christian era, and, next to flax, it was the most extensively used vegetable fiber until the introduction of cheaper cotton and jute. Hemp is now cultivated commercially in Russia, Austria-Hungary, Italy, Turkey, China, Japan, and the United States. In Europe several rather distinct varieties of hemp are grown, the principal types being the Piedmont of France

and northern Italy; the Neapolitan of southern Italy; the Smyrna of Turkey and Asia Minor; and the Russian of Russia and Hungary. All of these, and also the Japanese, Chinese, and Kentucky (or China-American) hemp, belong to the same species, *Cannabis sativa* L. This is the only true hemp, but the name hemp is unfortunately applied to many other fibers, most of which are quite different in character. About 15,000 acres in this country are annually devoted to hemp production. Nearly all of this is in the bluegrass region of Kentucky. Small areas—less than 1,000 acres in all—are cultivated near Lincoln, Nebr., and at Gridley and Rio Vista, Cal. The total production of hemp fiber, varying from 6,000 to 9,000 tons, is not sufficient to supply the demands of our manufacturers, and more than 4,000 tons are imported annually, chiefly from Italy and Russia. Hemp fiber, prepared by water retting as practiced in Italy, is of a creamy-white color, lustrous, soft, and pliable. It makes a satisfactory substitute for flax, and is used for medium grades of nearly all classes of goods commonly made from flax, except the finer linens. When prepared by dew retting as practiced in this country, the fiber is gray, and somewhat harsh to the touch. It is used for yacht cordage, ropes, fishing lines, linen crash, homespuns, hemp carpets, and as warp in making all kinds of carpets and rugs.

JUTE.

Jute fiber is obtained from two closely related species, *Corchorus olitorius* and *Corchorus capsularis*, native in Asia. Both are cultivated largely in Bengal, India, and to a less extent in China, Japan, and Formosa. The plants are annuals, belonging to the linden family. In general habit of growth they resemble Kentucky hemp, attaining a height of 8 to 12 feet, with no branches or only a few small ones near the top. Jute grows best in rich alluvial soils along rivers. The seed is sown in the spring, either broadcast in the field or sometimes in carefully prepared beds, from which the seedlings are afterwards transplanted. The plants are harvested either by cutting close to the ground or by pulling them up by the roots. In Formosa the fiber is stripped from the fresh green stalks as soon as pulled, and these ribbons, called "hemp skins," are afterwards retted by soaking them in water, and the fiber cleaned by drawing it between a blunt knife and a block of wood. In India the jute is either cut or pulled, and is retted by immersing the bundles of stalks in water. The fiber is afterwards cleaned by hand processes from the wet stalks.

The coarser fiber from the base of the stalks, 5 to 25 inches in length, is cut off and placed upon the market as jute butts. The remainder of the fiber is fine, soft, glossy, pliable, and easily spun. When fresh it is of a light creamy-white color, but it changes to a dingy yellow upon exposure. It also loses its strength, especially if exposed

to moisture. It is the cheapest fiber used in American textile manufactures, and it is employed in greater quantities than any other except cotton and sisal. Jute butts, ranging in price from 1 to 2 cents per pound, are used for making paper, and also for coarse bagging, cotton-bale covering, and the cheaper grades of twine. The longer fiber, selling in this country for $2\frac{3}{4}$ to $3\frac{1}{4}$ cents per pound, is used for wool twine, binder twine, jute rugs and carpets, grain sacks, and even for filling in heavy silk goods. The importations of jute fiber and jute butts amount to more than 100,000 tons a year, and the consumption in this country is steadily increasing. Experiments in the cultivation of jute in this country have proved that the plants may be grown successfully in the Southern States, but without suitable machinery for preparing the fiber the industry can not be carried on profitably.

HARD FIBERS.

MANILA FIBER.

Manila fiber, often called manila hemp, is obtained from the leaf sheaths of a kind of banana plant native in the Philippines. There are several varieties recognized in the different provinces, but all are known by the name abacá, and all have been regarded heretofore as belonging to one species, *Musa textilis* (Pl. XLVIII, fig. 1). Recent investigations conducted by the Bureau of Agriculture of the Philippines indicate that there are probably several distinct but closely related species cultivated for the production of manila fiber.

Abacá plants are cultivated successfully only in a comparatively small portion of the Philippines—in southern Luzon, and in Mindanao, Negros, Leyte, Cebu, Masbate, Mindoro, Marinduque, and Samar. In these regions there is an abundant rainfall and a relatively high humidity of the atmosphere. The plant grows best in volcanic soil on hillsides where there is good natural drainage. It can not be grown successfully in wet, swampy land or in soil that becomes dry.

The plants are propagated chiefly by suckers, which spring from the roots of mature plants. These are set out in rows 5 to 8 feet apart in each direction. Cultivation consists chiefly in cutting down weeds which would otherwise grow up and choke out the abacá. About three years are required for the plants to reach maturity when propagated from cuttings, or about five years when grown from seeds. They attain a height of 8 to 20 feet, the trunk being composed chiefly of overlapping leaf sheaths. When the flower bud appears the entire plant is cut off close to the ground. The leaf sheaths, 5 to 12 feet in length, are stripped off, separated tangentially into layers a quarter of an inch or less in thickness, and these in turn split into strips 1 to 2 inches in width. While yet fresh and green these strips are drawn by hand under a knife held by a spring against a piece of wood. This scrapes away the pulp, leaving the fiber clean and white. After

Yearbook U. S. Dept. of Agriculture, 1903.

FIG. 1.—FLAX GROWN FOR FIBER AT NORTHFIELD, MINN., READY FOR HARVEST.

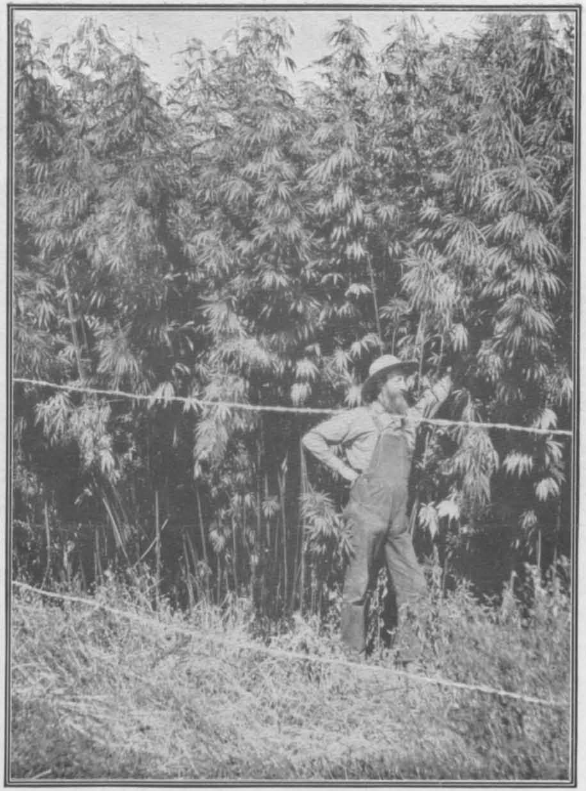

FIG. 2.—HEMP ON ALLUVIAL SOIL AT GRIDLEY, CAL.

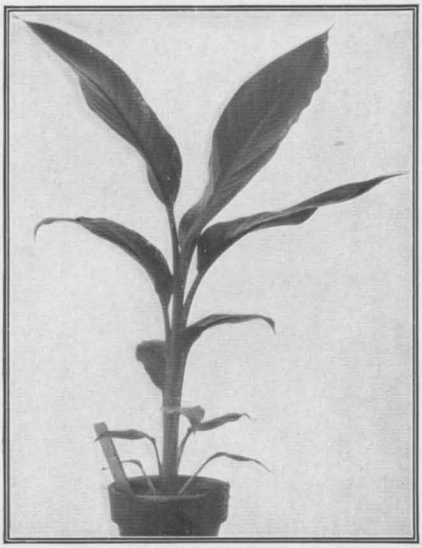

FIG. 1.—ABACA, SEEDLING OF PLANT PRODUCING MANILA FIBER.

FIG. 2.—NEW ZEALAND "FLAX."

FIG. 3.—SISAL PLANTS, GROWING IN THE BAHAMAS.

drying in the sun the fiber is tied in bunches and taken to the principal towns or to Manila to be baled for export.

The average yield of fiber is about 650 pounds per acre. The price in the New York market during the past ten years has ranged from 4 to 14 cents per pound. Manila fiber ranks first among the resources of the Philippine Islands, amounting to more than 60 per cent of the total value of exports. The importation of this fiber into the United States has been rapidly increasing since the war of 1898. During the calendar year 1903 more than 500,000 bales of 270 pounds each were brought to this country.

The best grade of manila fiber is of a light buff color, lustrous, and very strong, in fine, even strands 6 to 12 feet in length. Poorer grades are coarser and duller in color, some of them yellow or even dark brown, and lacking in strength. The better grades are regarded as the only satisfactory material known in commerce for making hawsers, ships' cables, and other marine cordage which may be exposed to salt water, or for well-drilling cables, hoisting ropes, and transmission ropes to be used where great strength and flexibility are required. The best grade of binder twine is made from manila fiber, since owing to its greater strength it can be made up at 650 feet to the pound as compared with sisal at 500 feet.

SISAL.

The sisal plant (*Agave rigida*) usually known as henequen in Spanish-speaking countries, is native in Yucatan (Pl. XLVIII, fig. 3). It has been introduced in many other tropical countries, but its cultivation for fiber on a commercial scale is confined to Yucatan, the Bahamas, Turks Island, Cuba, and Hawaii. Recent plantations have been made in Venezuela, in Santo Domingo, and in the Bombay and Madras presidencies in India.

The sisal plant requires for its best development a soil composed chiefly of limestone and a warm and comparatively dry climate. Clear, dry weather, with bright sunshine, is required to dry and bleach the fiber, while in rich, moist soil or in a moist climate the leaves develop too large an amount of pulp in proportion to the fiber.

The sisal plant is propagated by suckers springing from the roots of old plants, or from bulbils. Bulbils, called "mast plants," are produced in great numbers on the flower stalks in place of seed pods, like onion sets. The plants are set out during the rainy season, in rows 4 to 8 feet apart, in holes dug in partly disintegrated coral or lime rock with crowbars, pickaxes, and sometimes with the aid of dynamite. The ground where sisal is grown is usually too rocky to permit any stirring of the soil. About the only care given is to cut the brush and weeds once or twice each year. The weeds and brush, largely leguminous plants, by decaying on the ground add fertility to the soil. The first crop of outer leaves of the plants is cut at the end of three years when grown

from suckers, or four years when grown from mast plants. From ten to twenty leaves are produced each year for a period of twelve to twenty-five years in Yucatan, ten to fifteen years in Cuba, and six to twelve years in the Bahamas. An unusually cold winter at any period tends to check growth and cause the plants to send up flower stalks, after which they die.

Sisal fiber is cleaned from the leaves by machines which scrape out the pulp and at the same time wash the fiber in running water. It is then hung in the sun to dry and bleach for from one to three days, after which it is baled for market. The average annual yield is about 600 pounds of clean, dry fiber per acre. The price during the past ten years has varied from 2¾ to 10 cents per pound. More than 600,000 bales, averaging about 360 pounds each, were imported during the calendar year 1903.

Sisal fiber of good quality is of a slightly yellowish-white color, 2½ to 4 feet in length, somewhat harsher and less flexible than manila fiber, but next to that the strongest and most extensively used hard fiber. It is used in the manufacture of binder twine, lariats, and general cordage, aside from marine cordage and derrick ropes. It can not withstand the destructive action of salt water, and its lack of flexibility prevents it from being used to advantage for running over pulleys or in power transmission. It is used extensively in mixtures with manila fiber.

NEW ZEALAND HEMP.

The plant producing the fiber known in our markets as New Zealand hemp or New Zealand flax is a perennial belonging to the lily family, and is technically known as *Phormium tenax* (Pl. XLVIII, fig. 2). It is native in the coast regions of New Zealand, and is cultivated commercially only in those islands. The plant is hardy, withstanding a considerable degree of cold and drought. It is cultivated as an ornamental plant in parks and private grounds in the coast region of California, and also on the west coasts of Ireland and Scotland. Several different varieties are cultivated in New Zealand, some with leaves 6 to 8 feet long, others with leaves only half that length, 1½ to 3 inches in width, and of rather thin texture. The fiber is cleaned from the freshly cut leaves by scraping, washing, and drying. The scraping process is performed chiefly by machinery, but no machine has yet been used which will do all of the work satisfactorily.

The fiber is 40 to 60 inches long, nearly white, fine, and rather soft for a leaf fiber. It is used as a substitute for sisal in binder twine, baling rope, and medium grades of cordage, and is made up largely in mixtures with manila or sisal, except in the cheaper tying twines. By extra care in preparation and hackling, a quality is produced almost as fine and soft as the better grades of flax, and when thus prepared it may be spun and woven into goods closely resembling linen. Before

Yearbook U. S. Dept. of Agriculture, 1903.

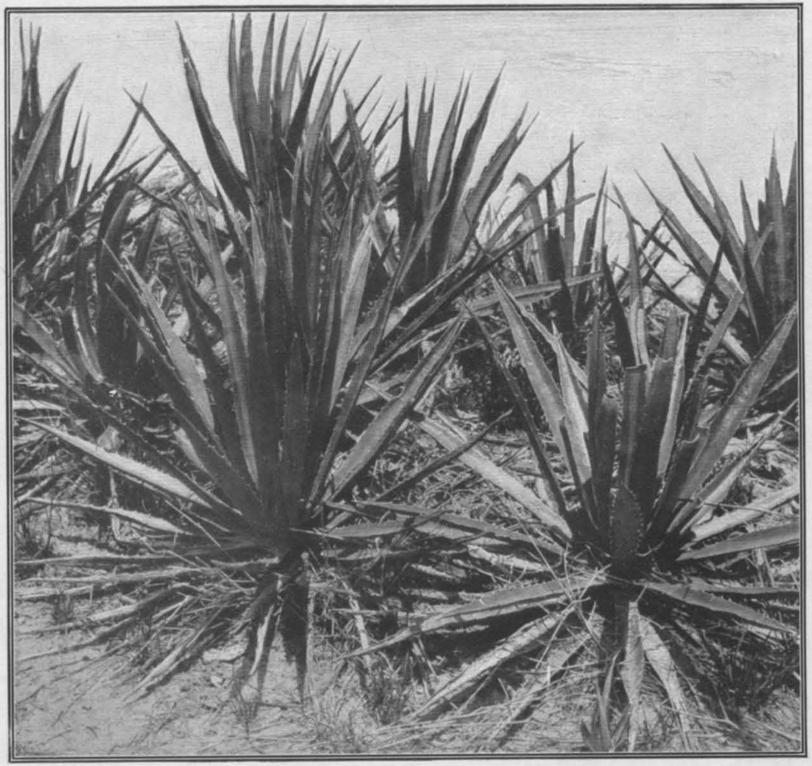

FIG. 1.--LECHUGUILLA PLANTS, PRODUCING JAUMAVE ISTLE.

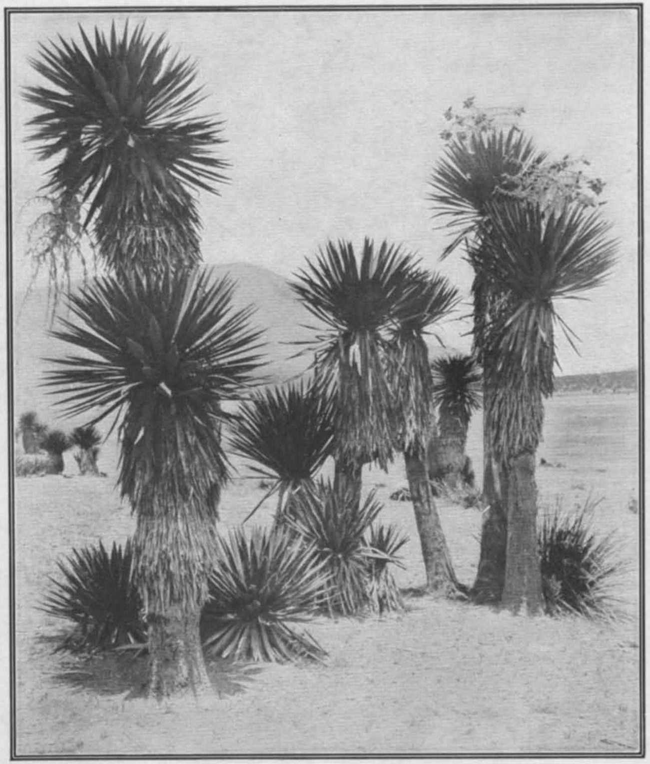

FIG. 2.—PALMA SAMANDOCA, FROM WHICH PALMA ISTLE IS OBTAINED.

being exported from New Zealand the fiber must all pass a rigid inspection, to insure uniformity in grading and prevent the shipment of inferior qualities. Since this system of inspection went into effect, in 1901, the importations of New Zealand hemp into this country have increased from 3,915 to 10,674 tons annually, and the price has advanced from $110 to $142 per ton.

MAURITIUS.

Mauritius fiber or mauritius hemp, as it is often called in the market, is obtained from the large, fleshy leaves of an agave-like plant (*Furcræa fœtida*). This plant is widely distributed in the tropics of both hemispheres. In Porto Rico it is known as maguey, probably from its resemblance to the maguey of Mexico, and in Hawaii it is called malino, a corruption of manila.

The fiber is produced commercially only on the island of Mauritius, though there seems to be no good reason why the industry should not succeed elsewhere. The plant is more hardy and thrives under a greater diversity of soil and climatic conditions than any other important fiber plant of this class. It is propagated by suckers or by bulbils in the same manner as sisal, and the fiber is cleaned partly by machinery. The preparation of the fiber involves the same processes, scraping, washing, and drying, as in the case of sisal. Under favorable conditions the yield ranges from 1,000 to 1,500 pounds per acre. The fiber is whiter and softer than other hard fibers, but it is weaker than sisal. It is used in the manufacture of gunny bags, halters, and hammocks, but more largely for mixing with manila and sisal in making medium grades of cordage. When the better grades of cordage fiber (manila and sisal) are abundant and quoted low in the market, mauritius is likely to fall below the cost of production.

ISTLE.

The increasing demand for cordage and twines of all kinds during the past few years has led to the substitution of istle fiber for the cheaper grades, whereas this fiber had been regarded heretofore as suitable only for use in the manufacture of brushes.

Istle or Tampico fiber is produced by four or five different species of plants which grow on the high arid table-lands of northern Mexico. The most important of these are the Jaumave lechuguilla (pronounced How-mah′-ve lech-u-guee′l-ya), producing the best grade, Jaumave istle (Pl. XLIX, fig. 1); lechuguilla, producing a medium grade, Tula istle; and palma samandoca and palma pita, producing palma istle, about equal in value to Tula istle.

The production of Jaumave istle is confined chiefly to the fertile Jaumave Valley, about 70 miles by road over the mountains south of Victoria, in the State of Tamaulipas. The fiber is obtained from the leaves of an agave plant, known technically as *Agave lophantha*. The

plant is not cultivated, but it grows abundantly on the mountain sides and out on the gravelly plain at the base of the mountains. Only the young inner leaves, forming the central spindle-like bud, are used. These are collected and the leaves taken up one by one and cleaned by drawing them, first one end then the other, under a blunt knife pressed against a block of wood. More than 30 tons of this fiber are produced in the vicinity of Jaumave every week, and all of it is shipped on the backs of burros over the mountains, a long two days' journey, to the railway at Victoria.

Tula istle is obtained from the lechuguilla plant (*Agave lecheguilla*), which is widely distributed on the high lands of Mexico and extends into western Texas and New Mexico. The fiber is produced most abundantly in the vicinity of Tula, about 60 miles south of Jaumave, in the State of Tamaulipas. It is obtained from the inner leaves of the plant, and is cleaned in exactly the same manner as Jaumave istle.

Palma istle is obtained from the inner leaves of yuccas, known in Mexico as palmas. The species producing most of this fiber is called palma samandoca (*Samuella carnerosana*—Pl. XLIX, fig. 2). This plant has a trunk 6 to 15 inches in diameter, and attains a height of 6 to 15 feet, bearing at the top a dense cluster of sword-like leaves, 20 to 30 inches long. Some of the palma istle is produced by the plant known as palma loco, or palma pita (*Yucca treculeana*), found in Coahuila and Nueva Leon. This yucca is very similar in appearance to palma samandoca, though usually with shorter trunk and longer leaves. The central cluster of unopened young leaves is collected and cleaned in the same manner as the leaves of the lechuguilla plants, except that they have to be steamed two to four hours to loosen the tissues before the pulp can be scraped out. The fiber is discolored by the steaming process, but this is partly corrected by bleaching in the sun as it dries.

Palma istle fiber is 15 to 35 inches in length, usually coarser and stiffer than sisal, yellow in color, and somewhat gummy. Tula istle is 12 to 30 inches long and nearly white in color. Jaumave istle is 20 to 40 inches long, rarely longer, almost white, and nearly as strong and flexible as sisal. The importations of istle fiber into the United States have increased from less than 4,000 tons in 1900 to more than 12,000 tons in 1903. Istle fiber has long been used as a substitute for bristles in the manufacture of brushes, and it is now being employed in increasing quantities in the cheaper grades of twine, such as lath twine, baling rope, and medium grades of cordage. Introduced at first as an adulterant or substitute for better fibers, it seems destined to find, through improved processes of manufacture, a legitimate place in the cordage industry. If machines are devised for cleaning this fiber in a satisfactory manner it is thought that the thousands of acres of lechuguilla plants in western Texas may be profitably utilized.

RELATION OF SUGAR BEETS TO GENERAL FARMING.

By C. O. Townsend,
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INTRODUCTION.

A large part of the sugar-beet belt of the United States lies within the region devoted to general farming, and, so far as can be ascertained, about fifteen-sixteenths of all the sugar beets produced in this country this year have been grown by men who are devoting themselves to the production of more or less diversified crops. In fact, the methods of rotation and fertilization practiced in general farming are, as a rule, conducive to the best results in sugar-beet production. It is not to be expected that large numbers of those agriculturists and horticulturists who have specialized along other lines for any considerable period will, in the near future at least, expend a great amount of time and energy in the production of sugar beets. It is therefore evident that the future progress of the beet-sugar industry must depend in a large measure upon the attitude of the general farmer toward the crop which forms the basis of this new industry. In turn, the attitude of the farmer toward sugar-beet growing will naturally depend almost wholly upon the amount of profit derived from the labor and money invested.

Each year come reports of phenomenal yields and almost incredibly high percentages of sugar and purity in various sections of the sugar-beet area, but it must be conceded that the general averages of tonnage and quality are far too low to produce a satisfactory average profit, and far lower than they should be considering the high averages that are possible in isolated cases.' For example, last year the average yield of about 5,000 acres of beets grown for one factory was less than 8 tons per acre, with an average sugar content of 14 per cent and an average purity coefficient of 80. There were, in that 5,000 acres, fields that yielded nearly 30 tons per acre, with a sugar content of 18 per cent and a purity coefficient of 83. In some instances the low averages are occasioned by unfavorable conditions over which the grower has no control, but generally speaking the result is due to one or more of three tangible conditions: (1) The man is not adapted to the work of growing sugar beets; (2) his land is not suitable in quality; or, (3) his location is unfavorable. The very best farmers, with suitable land,

well located, will sometimes fail to reap satisfactory returns from this or that crop, but the fact that the general averages in sugar-beet production are each year far below the demonstrated possibilities should lead to a careful consideration of the causes which tend to this condition, with a view to improving the yield and quality of beets produced.

THE SUGAR-BEET GROWERS.

The general farmer, the man who grows the bulk of the beets used in the manufacture of beet sugar, is the most important factor connected with the beet-sugar industry. When the beet is taken from the ground at harvest time the sugar is already made. The root that we call the beet is only the receptacle that contains the sugar. The whole process that the beet undergoes at the factory consists simply in separating the sugar from its receptacle and from the other substances contained with the sugar in the beet. From each ton of beets it is possible to separate about 200 pounds of sugar; more if the sugar percentage and purity coefficient are high, but less if they are low. The tonnage especially will be more or less affected by the care which the crop receives; hence the available sugar per acre depends largely upon the grower.

The successful grower must be willing to adopt new methods, and new tools, if necessary, and in practically all the beet-growing sections both new methods and new tools are necessary. He must be willing to accept suggestions from those who have had experience. He must study carefully the relation of this new crop to his general practice in regard to rotation, fertilization, soil preparation, stock feeding, etc. He should possess good judgment, so that he will not undertake more than he can carry through successfully. The fact that he can grow 100 acres of wheat successfully is not an indication that he can grow even 50 acres of beets with profit. Beet growing calls for intensive farming, and the grower must be able and willing to look after the necessary details. If he intends to grow beets extensively he must also be able to handle labor to the best advantage.

It is far better for the grower to begin in a small way and to increase his acreage gradually as he becomes familiar with the new methods involved. No crop responds more freely to prompt and careful attention than sugar beets. The grower should be a systematic man of prompt action. Failure to prepare the soil, or to plant, or to thin, or to cultivate at the proper time, may make all the difference between gain and loss at the end of the season. Over 40,000 farmers have grown sugar beets for the production of sugar during the past season. Of this number, probably 10,000 would have had better results had they given more careful attention to the details of the work. Some have failed through no fault of their own, and under more favorable conditions may be highly successful. Many of those who have had

only partial success will be able to profit by their experience and produce a good crop next year, while some have undoubtedly learned that they are not adapted to this intensive line of farming.

Above all, the grower should not expect impossible things from the beet crop either in the field or in the price per ton. It is probable that the average tonnage, the average percentage of sugar, and the average coefficient of purity will all be considerably increased in the years to come, both by improved methods of farming and by continued attention to the selection of the mother beets; but it is certain that there is a limit beyond which it is impossible to advance along any of these lines of improvement.

In regard to the price of beets, it should be noted that at the present price of sugar the grower receives nearly one-half the market value of the sugar for his beets.

THE SOIL.

In the selection of soil for sugar-beet production, the tonnage, the sugar content, and the purity coefficient must all be considered. If tonnage alone were desired the problem would be much simpler; but as a rule (to which there are some exceptions) unusually large beets are lower in sugar content than the smaller ones. The time may come when, by proper selection and care, the larger beets will generally contain as high as or even a higher percentage of sugar than the smaller ones do now; but, under existing conditions, it is sometimes possible to get better returns from a smaller than from a larger tonnage. For example, 12 tons per acre of 12 per cent beets at $4.50 would bring $54, whereas 10 tons of 15 per cent beets at the same price, plus an additional 33⅓ cents for each additional 1 per cent of sugar, would bring $55, with the cost of production in favor of the smaller tonnage. This being true, that soil is best adapted to the production of sugar beets which will yield a fair tonnage with a high percentage of sugar, provided the coefficient of purity is not lowered. An ideal condition would be a large tonnage with a high sugar percentage and a high coefficient of purity; but, as already pointed out, the beet has not yet been developed to that extent.

There are several kinds of soil which, under proper conditions, will produce good sugar beets. Experience has shown that a clay loam containing a sufficient supply of humus is one of the best sugar-beet soils. Likewise a sandy loam containing a proper amount of humus is usually satisfactory. In some portions of the West and Middle West there is a soil known as adobe, which, though somewhat difficult to till, gives good results when planted to sugar beets. In some of the fertile valleys of the West there is a black soil almost inexhaustible because of its great depth, which yields a fine, rich beet. As a rule, the so-called muck soils are not satisfactory for this crop, but when properly drained,

fertilized, and tilled they produce a satisfactory quantity and quality of sugar beets, especially if they have a rather firm subsoil. The stony or gravelly soils and the loose sandy soils should usually be avoided in selecting sugar-beet land. However, some good crops of beets have been grown even in these unfavorable soils, though these have been exceptional cases.

Soils that are strongly alkaline are not to be recommended for sugar-beet culture, although the beet is more resistant to alkali than most of our farm crops; and indeed soils that are too strongly alkaline for nearly all other crops will sometimes produce a fair yield and quality of sugar beets. Undoubtedly, many of the alkaline soils of the West could be rendered suitable by proper treatment not only for sugar-beet growing but for general farming.

As a rule, a virgin soil should not be used for growing sugar beets, even if it is of the kind that usually gives good results from sugar beets in rotation with other crops. The virgin prairies, however, are more likely to produce good results the first few years than are the virgin timber lands, and a notable example of the value of virgin prairie soil for sugar-beet growing is seen at Sugar City, Colo., where the fourth crop was produced this year.

It should be noted also that the nature of the subsoil is an important factor in sugar-beet production. If the subsoil is too hard the beets will not penetrate it readily, and as a result will be pushed out of the ground in the process of growth. This may usually be remedied, however, by the use of the subsoil plow. The subsoil should not be impervious, as this prevents a proper drainage; on the other hand, it should not be too loose, as this allows the water to pass through too freely. While the beet is capable of withstanding extremes of moisture better than most farm crops, it is entirely possible for its growth to be checked by either too much or too little water.

THE LOCATION OF LAND FOR SUGAR BEETS.

The location of the land on which sugar beets are to be grown should be considered from several standpoints. So far as sugar-beet growing has been tested, there are fairly well-defined limits beyond which the crop is not profitable.

It is possible that the sugar beet may be so acclimated as to extend considerably its present geographical limits. However, the present satisfactory sugar-beet territory in the United States is sufficient for the production of all the sugar needed on the American continent, and will therefore accommodate the expansion of the beet-sugar industry for many years to come. Geographically, the sugar-beet territory is a somewhat wedge-shaped area, which extends from the Pacific to the Atlantic, with the broad end of the wedge toward the Pacific, comprising nearly the whole of the States of California, Oregon, and

Washington. The whole area tapers irregularly toward the East, the line of the southern boundary running north of Maryland and passing into New England. South of this area the mean temperature is too high for proper sugar production, although the tonnage produced is usually satisfactory. North of the sugar-beet area the season is too short to allow the beets to ripen thoroughly; hence the sugar content is too low for profit. In addition to the temperature limits there must be, as already indicated, a sufficient supply of moisture; but it is immaterial whether the water be supplied in the form of rain or by the process of irrigation.

It is desirable that the land be located within easy reach of the factory, either by rail or by wagon road. It is usually more satisfactory to transport the beets by wagon, providing the roads are sufficiently level and firm to admit of hauling several tons at each trip and the distances are not too great. Both steam and electric cars are now used in different parts of the United States for transporting the beets to the factory. If the transportation is over one line of road only, the rates are usually not excessive; but it adds one more item to the cost of production without materially decreasing the labor, since the beets must be loaded into the wagon in the field and unloaded into the car, which is often more difficult than unloading at the factory. Unfortunately, but few of the railroads have cars suitable for handling beets. At some points where beets might otherwise be grown to advantage it is quite impossible to get suitable sidings upon which the cars may be loaded, or even to get the necessary cars for transporting the crop. These difficulties, however, are gradually disappearing, and the sugar-beet industry is making headway in improved railroad facilities and in improved highways, both of which mean much to the general farmer who has many things to transport in addition to his beets.

The particular field upon which sugar beets are to be grown should be easily accesssible, so that the beets may be hauled out without any special difficulty. It should be comparatively level, especially if it is to be irrigated. Fields not sufficiently level for irrigation may often be made so, provided the soil is of adequate depth to permit of leveling the knolls without laying bare the hardpan. In the valleys where irrigation is necessary, the fertile soil is fortunately of considerable depth. Hillsides should not be planted to sugar beets, for the reason that the plants do not prevent the field from washing. An attempt to grow beets in such a location, even though the soil itself were suitable, would not only result in a failure of the crop, but would also seriously injure the field for succeeding crops. Light sandy fields should be avoided, not only because the soil is unsuited for sugar-beet production, but because the sand is likely to be blown over the young beets and smother them. A low, wet field should not be used for sugar beets until it has been properly drained.

PREPARATION OF THE SOIL.

It is sometimes necessary to begin preparing the soil several years before planting it to beets in order to reach the best results. This is especially true of new land or of any soil in which the grass and weeds have not been thoroughly subdued. The more carefully the soil is prepared and the freer it is from grass and weeds the less the labor and expense in caring for the beet crop.

The whole process of rotation may be looked upon as preparation of the soil for the crop of sugar beets. The same principle applies to all other crops, that is, a rotation should be practiced which leaves the soil in the best possible condition for the succeeding crop. Any rotation which leaves the soil mellow and well supplied with humus, but free from weeds, stubble, and other material that might clog the drill or tear up the young beets when cultivated may be considered a good system of rotation for sugar beets. It is the practice in some sections of the sugar-beet area to grow wheat year after year upon the same soil without the application of any plant food or humus, the result being that the yield gradually decreases and the soil is not in good condition for any crop. However, sugar beets grown on the same land after several successive crops of wheat will gradually increase in yield for several years, and if the third or fourth crop of beets is followed again by wheat the yield of grain is very much larger than it was before the beets were grown. This is undoubtedly due to the fact that the soil is put in better condition for the grain crop, as the beets certainly impart nothing to the soil that is of value to the wheat.

Notwithstanding the prevailing opinion to the contrary, the general experience is that sugar beets are not especially injurious to the soil. Wheat and oats invariably do well after beets. Corn usually does not start off so well, but as a rule the final result is just as satisfactory whether corn or any other crop follows beets. Indeed, it is possible by generous applications of barnyard manure to grow beets after beets for many years with satisfactory results. Pl. L, fig. 1, shows the thirteenth consecutive crop of beets on a field at Lehi, Utah. This illustration is from a photograph taken about September 1, and the beets were then above the average in size and quality as compared with those grown under the various systems of rotation. However, all things considered, it is better to rotate in most parts of the sugar-beet area, since the soil is thereby less likely to become infected with disease germs, and because of the cultural advantages usually secured by rotation.

In regard to the immediate preparation of the soil, fall plowing is desirable and should be done in all cases if possible. The soil should be broken up to a considerable depth. Subsoiling is not so generally practiced as formerly, but it should be practiced where there is a hard

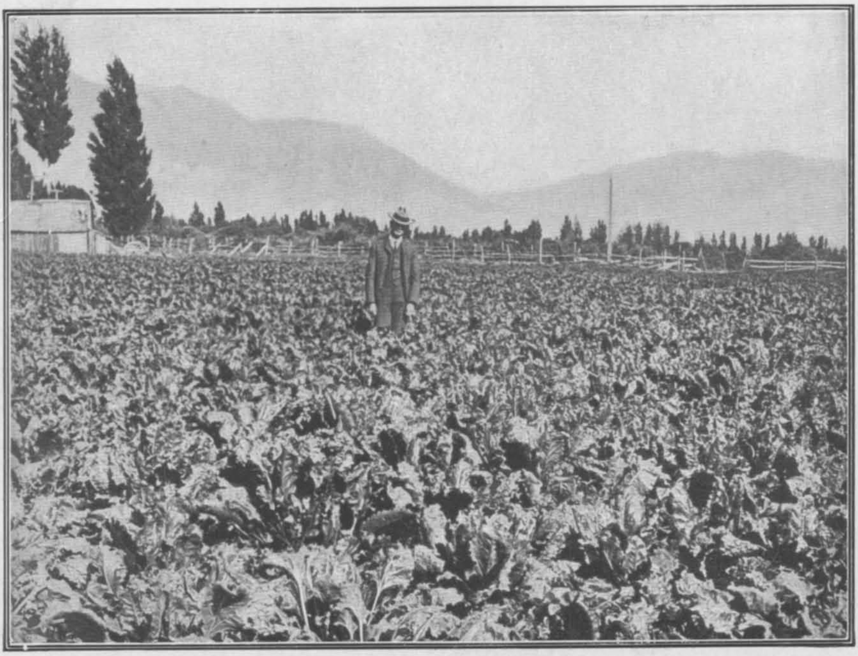

FIG. 1.—THIRTEENTH CONSECUTIVE CROP OF SUGAR BEETS ON A FIELD AT LEHI, UTAH.

FIG. 2.—A 40-ACRE FIELD OF SUGAR BEETS, GROWN UNDER IRRIGATION AT ROCKYFORD, COLO.

subsoil comparatively near the surface. In those sections where the rich, loamy soil is very deep, subsoiling is not necessary, but the surface plowing should be as deep as possible. When the fertile soil is comparatively thin, however, and shallow plowing has been practiced, it is not advisable to plow very much deeper than usual, that is, it is not desirable to turn up a considerable amount of crude subsoil to the surface, but the depth of the plowing may be gradually increased by plowing a little deeper each year.

After the soil has been exposed to the weather during the winter the seed bed should be thoroughly prepared as early in the spring as possible, but the seeds should not be put into the ground until the soil is warm enough to allow them to germinate readily and the young plants to grow normally. It is very much less expensive to work the soil before planting than afterwards, and the more thoroughly the seed bed is prepared the easier it will be to keep the field in proper condition for the best development of the beets. (Pl. L, fig. 2.) The soil of the seed bed should be deep, fairly fine, and easily penetrated by the roots. It should also be capable of retaining moisture and at the same time admit of a free circulation of air.

PLANTING.

A good stand of beets is the first requisite for a profitable crop; hence plenty of seed should be used—about 15 pounds per acre usually giving satisfactory results under the present method. The seed should be covered to a depth of from one-fourth to one-half inch only, and there should be sufficient moisture distributed evenly in the soil to produce uniform germination, otherwise an uneven stand will result. On the other hand, the soil should not be too wet at the time of planting, as this condition will cause some of the seeds to rot, thus producing an imperfect stand. The seed is usually planted in solid rows about 18 inches apart, and the beets are thinned to 8 or 10 inches in the row. Hill planting has been used to some extent, but it has not yet become general, as the growers fear they will not be able to get a good stand by this process. If the hill method or some modification of this method could be used, it would greatly reduce the amount of seed required per acre, and at the same time would do away with the labor of blocking.

CARE OF BEETS.

There is no question connected with farming in the arid West that is more interesting or more important than water rights and the proper use of irrigating waters. To be able to supply water to any crop at the time and in the quantity desired is a factor in agriculture with which few farmers in the Eastern States are familiar. Sometimes it is necessary to irrigate soon after planting in order to get the crop

up; in other instances water need not be applied until the crop is well advanced. (Pl. LI, fig. 1.) Usually from two to five irrigations are required to produce a crop, depending upon the location and the season, but it is possible under some conditions for a crop to be made without the application of water in any form to the surface of the ground. Pl. LI, fig. 2, represents an experimental field at Smithfield, Utah, grown by the Department of Agriculture in cooperation with the Utah experiment station, which was planted in May and harvested toward the latter part of October. There was a light shower the day the seed was planted, but the field received no more water upon its surface, either in the form of rain or by irrigation during the entire season, and yet it was one of the most satisfactory fields of beets produced in that part of the sugar-beet area. In the sections where rainfall is the source of water supply beets often suffer either from excess or scarcity of moisture. Much may be done to alleviate these unfavorable conditions by good drainage and by thorough surface cultivation.

As soon as the beets are up they should be blocked and thinned, any delay in performing this work being likely to reduce the tonnage. Blocking consists in cutting out the beets so that they stand in little tufts 6 or 8 inches apart. This is usually done with a hoe, but a machine has recently been invented whereby several rows may be blocked at the same time. The thinning should immediately follow the blocking, and must be done for the most part by hand. It consists in removing all but one of the young beet plants from these little tufts, and is the most tedious and the most expensive single operation connected with sugar-beet growing. The fact that nearly all the beet-seed balls contain from two to seven seeds makes it impossible at present to avoid the thinning process. It is not probable that any implement can be devised that will satisfactorily remove the unnecessary seedlings without injuring the one that remains. The only solution of this problem seems to lie in the development of a plant that will produce only single-germ seed balls, and this the Department of Agriculture is attempting. It is impossible to make any safe prediction in regard to the length of time that will be required to perform this task, but the great importance that such a seed ball would bear to sugar-beet production will cause those who have the work in charge to endeavor to accomplish this end at the earliest possible moment.

Next to thinning, weeding is usually the most expensive operation, since this also must as a rule be done by hand. The cost of this process, however, depends very largely upon the condition of the soil with respect to the presence or absence of weeds and weed seed before the beets are planted. In addition to hand weeding, hoeing and cultivating are important factors in the suppression of weeds. It is usually

FIG. 1.—A FIELD OF SUGAR BEETS, GROWN UNDER IRRIGATION AT LA GRANDE, OREG.

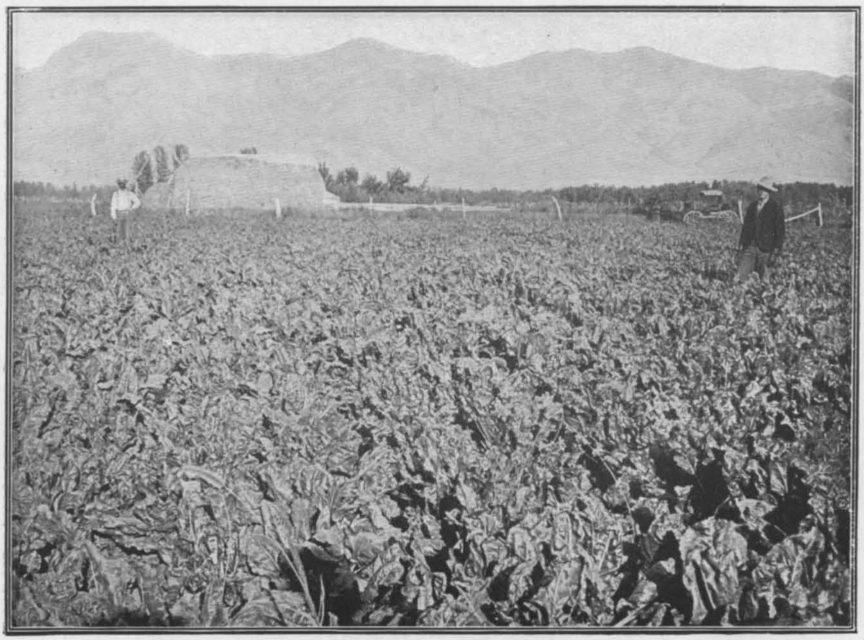

FIG. 2.—EXPERIMENTAL FIELD OF SUGAR BEETS AT SMITHFIELD, UTAH.

FIG. 1.—A FIELD OF SUGAR BEETS READY FOR THE FACTORY, AT BLISSFIELD, MICH.

FIG. 2.—CORNER OF A 12-ACRE FIELD OF SUGAR BEETS AT BLISSFIELD, MICH.

necessary to hoe the beets once or several times, and the number of cultivations will depend upon the condition of the soil and the weather. The object of hoeing and cultivating is twofold, namely, the destruction of the weeds and the conservation of moisture. In visiting the various sugar-beet sections one can not fail to be impressed with the number and size of the weeds that are allowed to thrive in some places while other localities are almost entirely free from weeds of any sort. In some sections weeds of various kinds line the roadway for miles, scattering their numberless seeds by all the methods with which nature has provided them. In most of the general farming operations weeds are not as costly as they are in sugar-beet production; hence this subject has not received in all communities the attention it deserves. The sugar-beet grower must realize that to suppress and control the weeds will greatly reduce the cost of raising his crops. This principle of agriculture, as well as many others, might profitably be taught in all our country schools.

HARVESTING.

When the beets are ripe they must be lifted or loosened in the ground, pulled, and topped. Several machines have been devised for performing this work, but as yet they have not come into general use. Most of the beets grown at present are loosened by means of a side plow or a double-pointed lifter, and are then pulled and topped by hand. In whatever way the beets are lifted they should not be broken. In pulling them they are usually thrown in rows, with the tops all one way, thus facilitating the topping, which is done by means of a large knife, and consists in cutting off the upper portion of the beet at the line of the first leaf. The beets are then thrown in heaps on the ground, which has been previously leveled and packed, so that they may be forked up and loaded into the wagon without taking a large amount of dirt and rubbish with them. (Pl. LII, fig. 1.)

Nearly all these operations in connection with sugar-beet growing differ more or less from the general farming processes now in common use, but in no respect are they so radically different that any farmer who is able to adapt himself to the necessary methods can fail to obtain good results if his soil and location are favorable. Moreover, he will thereby make a very valuable addition to his system of rotation that will be beneficial in many ways to his other crops.

LABOR.

One of the most serious problems that confront the farmer to-day is the question of labor, and this is especially true of the sugar-beet grower, since he requires more than the usual amount of help in caring for his beet crop. The scarcity of farm labor is general throughout the sugar-beet area. This condition has kept the acreage down in

many localities, causing the farmer to plant only the small area that he, with the help of his family, is able to care for. In a few localities the sugar companies have undertaken to supply the growers with the necessary help. This method has in general proved satisfactory, and will undoubtedly be more commonly adopted in the future, since the sugar companies are in better position than the individual farmers to secure labor and to distribute it properly.

Another serious question in this connection is the basis upon which the laborer should be employed. The common methods are by the day, the month, the season, the field, the acre, the row, and the ton. The cost of day labor has advanced from 25 to 50 per cent in some of the sugar-beet sections during the past few years. The same is probably true of the labor employed by the month or by the season. By employing labor on the time basis one can usually get the work done satisfactorily, if not so rapidly as desired. By using the field, acre, or row method the work is usually pushed more rapidly, but is not always done satisfactorily. The laborer has no special interest in the final result, and it matters little to him whether or not the stand is good or the beets make proper progress in development. The method of payment by the ton has some advantages in this regard, since it gives the laborer an interest in the highest possible yield.

The scarcity of farm labor and the difficulties that sometimes arise in having the work satisfactorily performed make it necessary, in the interest of the grower and of the industry in general, that means be devised to reduce the labor in sugar-beet production. This end may be reached either by the invention of machinery that will lessen hand labor or by producing those conditions that will render certain parts of the labor unnecessary, as for instance by the production of a single-germ seed ball, the destruction of weeds, and the more thorough preparation of the soil.

Pl. LII, fig. 2, shows one corner of a 12-acre field of beets owned by Mr. Henry Fritz, of Blissfield, Mich., who, with his two children, constituted the entire force that cared for these beets from the time the seed was planted until the beets were ready for the factory. The beets were well thinned and the field was entirely free from weeds. In the same locality another family of five cared for over 30 acres of beets, and one of the sons earned over $40 by helping one of his neighbors. The minimum of labor was necessary in these fields, owing to the excellent condition of the soil and to the scarcity of weeds before planting.

PROFIT AND LOSS.

It is generally conceded by sugar-beet growers that the outlay of money in producing this crop is greater than for almost any other crop that has a place in general farming. The cost of producing an acre of

sugar beets is variously estimated by the growers at from $20 to over $50, the higher cost including the rent of land and cash payment for all labor.

The implements needed for growing sugar beets that are not required in other farming operations are few and inexpensive. The tools used with other crops may be employed in preparing the soil, while the ordinary grain drill may be utilized in planting the seed. A special hoe for blocking, a special cultivator on account of the narrow rows, a lifter to loosen the beets, and a knife for topping are all the extra tools that are absolutely necessary. Other tools will certainly come into use in the future, but they will take the place of hand labor and will therefore tend to lessen expense in the long run. The cost of the seed is small, but there is no immediate prospect that the farmer will be able to grow his own seed; hence this will continue to be an item of expense.

Pl. LI, fig. 1, shows a field of sugar beets grown at La Grande, Oreg. The owner of this field has grown 120 acres of beets each year for four successive years, and has annually cleared $36 per acre after deducting all expenses, including the usual rental of land and his own time, which he values at $5 per day.

The average return to the individual grower for his beet crop has been at the rate of about $5 per ton, and the return to the farmers of the United States for the entire beet crop for the year 1903 was, in round numbers, $10,000,000. This amount has been distributed among practically 40,000 farmers, and a large part of it has been expended for labor, rent, tools, fertilizers, transportation, and irrigation; in fact, this money has gone into general circulation, benefiting the country at large. That part of the $10,000,000 which stands for profit has largely gone into general circulation also. It has gone to pay for the home, to buy better farming tools, to build new houses and new barns, and to supply the home with furniture, books, papers, and many other things that make life better.

In addition to the money value of the crop, the by-products are of no small importance. The value of the pulp as a stock feed is yearly becoming better known to the general farmer, the stock raiser, and the dairyman. A few years ago it was a serious problem at the factories to know how to dispose of the pulp; to-day it is impossible for some of them to supply the demand for this material for feeding purposes. The beet tops left in the field, amounting frequently to several tons per acre, are utilized with good results either for stock feed or as a green fertilizer. Some of the refuse molasses has been fed with the pulp, but while it has given satisfactory results it probably has a greater money value when used for other purposes. In addition to the direct benefits derived from the production of sugar beets, the farming community gains indirectly better highways, improved farms, and more thorough and intelligent farmers.

THE FUTURE OF THE BEET-SUGAR INDUSTRY.

The wonderful development of the beet-sugar industry during the past few years shows how admirably the soil and the climate of America are adapted to the production of sugar beets, and if past results are any indication of future possibilities the time will soon come when this country will produce all her own sugar. During the past six years 42 of the 55 factories now established have been built and equipped, at an expense of over $30,000,000. Every new factory gives the growers better facilities for disposing of their beets and calls for more farmers to engage in this new enterprise. The 55 factories and 3 rasping stations now established have a daily capacity of 37,000 tons of beets. Each of these factories should be in operation not less than ninety days annually, which would call for a yearly production of 3,330,000 tons of beets, from which 366,000 tons of sugar would be produced. At the present average production this would require 50,000 farmers to grow the beets, which, at the present price, would return to them $16,000,000 in cash. With this production of beet sugar in the United States, it would still be necessary to import nearly 2,000,000 tons of sugar to supply the present population at the present rate of consumption. To manufacture this sugar in this country would require more than 360 factories, with an average capacity of 500 tons of beets daily, in addition to those already in operation. These factories would require nearly 300,000 farmers to supply them with beets, for which they would receive $90,000,000, most of which would be put into general circulation.

It should also be remembered that the consumption of sugar is increasing annually, both by reason of the increase of population and because of the increased consumption per capita. The yearly consumption per capita has increased 8 pounds during the past ten years, that is, approximately 640,000,000 pounds, or 320,000 tons, more sugar was consumed last year than would have been consumed ten years ago had the population at that time been the same as it is at present. This is almost as much sugar as the 55 beet-sugar factories would have produced this year if they had been operated at full capacity, but as a matter of fact it is 80,000 tons more than they actually produced. This shows that the manufacture of beet sugar in the United States, in spite of its wonderful progress during the past decade, has not even kept pace with the increased rate of consumption. It is therefore apparent that if we had the several hundred factories necessary for the production of all the sugar demanded for our present requirements there would still be room for a normal growth of this industry through the constantly increasing consumption per capita and through the constant increase of our population.

THE INDUSTRY IN OIL SEEDS.

By Charles M. Daugherty,
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COTTON SEED AND FLAXSEED IN THE UNITED STATES.

The United States has, within the past quarter century, become by far the heaviest producer of oleaginous seeds in the world. This has been wholly due to the utilization of the cotton-seed crop and the expansion of flaxseed cultivation. Previous to these developments little attention was paid in this country to this class of agriculture. None of that great variety of purely oil-yielding seeds, the oils of which are of well-known edible and industrial importance in many foreign countries, was indigenous to the United States; and, notwithstanding the diversity of tastes and customs introduced into this country by a heterogeneous immigration, little or no effort was made to transplant them for their oil-yielding properties. In fact, it is solely due to the fact that some of the oleaginous-seed plants also yield valuable fibers that their cultivation was originally undertaken in this country. Textile materials being a prime necessity of civilized peoples, the flax plant was one of the first agricultural products introduced into the American Colonies. The cotton plant is believed to be indigenous to the New as well as to the Old World. With the exception of castor beans, the culture of which is a specialized industry in a few Western States, cotton and flax are the only oleaginous-seed plants that have ever been utilized to a notable extent in the United States for oil-making purposes. Oil has been manufactured in recent years, it is true, from corn, but only as a by-product of the glucose industry. Hemp, which is raised extensively in Russia for the oil from its seed, and peanuts, large quantities of which are imported into France from Senegal and the East Indies for manufacture into oil, are also raised in the United States, but not because of their oleaginous properties; and the small esteem in which the like properties of flax and cotton were originally held is evidenced by the fact that for two and a half centuries after the settlement of this country flax was cultivated chiefly and cotton exclusively for the value of the fiber. It is only within the past half century that, by an economic revolution almost unique in an age noted for the utilization of waste, the once most valued part of the flax plant has degenerated in this country into a waste product, and

the seed, formerly a secondary consideration, has become the sole object of cultivation. Within the same period, too, the rapidly increasing cotton-seed crop, previously only a troublesome waste product, has been made available as the greatest single resource for oleaginous seed in the world.

CULTIVATION OF OIL-YIELDING SEEDS IN FOREIGN COUNTRIES.

The cultivation of sunflower seed, rape seed, colza, poppy seed, sesamum, ravison, mustard seed, and many other exclusively oil-yielding seeds is a factor of considerable importance in the rural economy of many foreign countries. Some of these seeds yield edible oils, and hence are ranked among the necessities of life. Sunflower seed is extensively cultivated in Russia, where sunflower oil is one of the most popular of table oils; the seeds are also roasted and eaten as peanuts are in the United States. It is stated on good authority that 700,000 acres are annually devoted to the cultivation of sunflowers in Russia, and that 150 mills turn out an annual product of upwards of 25,000,000 gallons of sunflower oil. The other seeds mentioned are objects of special cultivation in British India and other Oriental countries, and, in a smaller way, in many parts of Europe. In France, Germany, and in most of the western and northwestern sections of Europe the culture of oil seeds has greatly declined, and is now of small importance. But an import demand exists there for practically the entire surplus oleaginous-seed crop of the world. The surplus of the flaxseed crop of Argentina, of the various oil-seed and nut crops of the East Indies, of the peanut and palm-kernel crops of the European possessions on the east and west coasts of Africa, of the cotton-seed crop of Egypt, and of various other crops of oil-yielding seeds and nuts from all parts of the world is annually absorbed by the European trade and converted into oil and oil cake in European factories for the use of European consumers.

ANIMAL FATS AND VEGETABLE OILS.

That none of the exclusively oil-yielding seeds has ever been cultivated in the United States for oil-making purposes has been due primarily to a lack of demand for their products. A distinctive characteristic of the American people, though modified in recent years, has been the use of animal fats, both in domestic and in industrial life, for many purposes for which the inhabitants of other countries largely employ vegetable oils. In domestic life there has always been in the mind of the American housewife a somewhat inexplicable prejudice against the use of vegetable oil for cooking purposes; and until recent years lard had completely usurped the functions here that from remote antiquity had been accorded in many countries to vegetable oils. That

this prejudice is being gradually mollified there is no doubt, but it is a tribute to its persistency that vegetable cooking oil even now gains surreptitious access to the American kitchen only under the guise of packages and labels suggestive of lard. For most industrial purposes, likewise, animal fats have been utilized to a large extent in the United States when for the same purposes vegetable oils were chiefly used abroad. Until the discovery of petroleum, the tallow candle and animal oils furnished an illuminating power in this country that in older ones was, and to some extent still is, supplied by colza oil and divers other oils of vegetable origin. For lubricating purposes, also, animal fats have been extensively used in the earlier history of the United States when for like purposes abroad the demand has been for rape-seed oil or other vegetable oils. In the manufacture of soap, wherein large quantities and many varieties of vegetable oils have always been utilized abroad, grease has been extensively used in the United States, especially in the homemade product of the farm. In fact, though several varieties of oil-yielding seeds, such as rape seed, poppy seed, and their oils, have been annually imported into the United States in considerable quantities for special purposes, the popularity of animal fats for all uses to which they are adapted has, together with other causes, had a tendency to restrict the use of such oils, and thereby not only to place a limit upon their importation, but also to discourage the production of the exclusively oil-yielding seeds upon American soil.

DEVELOPMENT OF FLAXSEED CULTIVATION IN THE UNITED STATES.

As late as 1860 the quantity of linseed oil manufactured from seed grown in the United States did not much, if at all, exceed 1,000,000 gallons a year; and, since the value of the oleaginous properties of the cotton-seed crop was then practically unrecognized, this quantity closely represents the total output at that date of all oil made from home-grown oleaginous seed. The use in this country of the products of oil-yielding seeds was at that time largely confined to linseed oil, valuable for its use in paint and varnish. But the domestic output of this product was entirely inadequate to the demand, and the imports of oil and seed, expressed together in terms of oil, amounted to about 6,000,000 gallons. Imports of other fixed or expressed oils, including rape seed, hemp seed, cocoanut, and palm oil, amounted to less than 2,000,000 gallons. The domestic consumption, therefore, of all oils of this class amounted in 1860 to less than 9,000,000 gallons. The marvelous advance that has been made in the production of oleaginous seeds and in the consumption of their oils in the United States since that date is illustrated by the fact that at the present time there is annually manufactured from the domestic crops of flaxseed and cotton seed a product of from 160,000,000 to 170,000,000 gallons of oil, three-fourths of which probably enters into home consumption.

The development of flaxseed cultivation on an important scale in the United States dates from the cessation of the civil war. In the activity of the westward movement of population, incident to the disbandment of the military forces, flaxseed culture, specialized and limited in territorial extent, moved with the tide of progress gradually westward and northwestward from the Ohio into the territory then known as the West and Northwest. Virgin soil seemed to be essential to its profitable cultivation. In the wake of agricultural expansion followed another economic movement, that of industrial enterprise, the course of which was marked by the building of homes and factories, the equipment of railways, and the growth of towns and cities—a movement that gave great impetus to flaxseed production in that it increased enormously the demand for paint, and hence for linseed oil, the principal object of flaxseed cultivation. The effect was immediately apparent. The flaxseed crop, which by 1869 had already increased to 1,730,000 bushels, was more than quadrupled in the next ten years. In 1879 it amounted to 7,170,000 bushels, and upward of 90 per cent of the crop was produced in the Western States, manufactured by Western mills, and consumed in territory west of the Alleghenies. There was little or no surplus, and the markets of the East were chiefly supplied by imports of flaxseed from British India. It was not until 1891, however, that the important point was reached in the history of the crop, when domestic supply overtook demand. Regular foreign imports to Eastern mills after that date ceased, and the United States took rank among exporting nations. Meanwhile the domestic demand for linseed oil had greatly increased, but the domestic production of flaxseed more than kept pace with this increased demand. The crop of 1903 amounted to 27,300,000 bushels, or 764,400 tons, and, notwithstanding the fact that the average exports of the previous five years had amounted to upward of 3,000,000 bushels annually, this crop came upon markets heavily overloaded with the surplus of the two preceding years. The industrial demand for flaxseed in the United States is practically limited to the domestic demand for oil, the export trade in the manufactured product being of small proportions. Potentially, the 1903 crop represents (after deducting 1,500,000 bushels for next year's seeding) 64,450,000 gallons of oil, or fully 15,000,000 gallons more than the country's requirements. The quantity actually manufactured each year does not exceed 50,000,000 gallons.

THE UNITED STATES AS A PRODUCER OF OLEAGINOUS SEEDS.

The position of the United States in the first rank as a producer of oleaginous seeds, however, is principally due to the utilization of the cotton-seed crop, and is the result of industrial rather than agricultural development. From the beginning of cotton cultivation in this country cotton seed had been in weight a relatively important, but in value

a worthless product of the cotton belt. Constituting in weight two-thirds of the seed cotton as picked from the boll, each annual increase in valuable cotton lint resulted in a double increase of worthless cotton seed. And a few years previous to the civil war something like 2,000,000 tons of this useless and cumbersome product was a result of each year's harvest. Beyond the small quantities used for cattle feeding and for fertilizing, there was probably little thought, less prospect, of its profitable utilization. The economic field that it was afterwards to share as a cooking oil and in the manufacture of soap was completely filled in the one case by lard, and in the other by other greases. Moreover, the building up of an export trade was debarred by the liability of the seed to heat in transportation. Cotton-seed oil was then manufactured in Europe from seed imported from Egypt; and a few sporadic attempts, probably based on the hope of an export trade in cotton-seed oil, were made to establish the industry in this country. The civil war checked whatever chance there might have been of success.

GROWTH OF THE MANUFACTURE OF COTTON-SEED OIL.

Within a few years after the cessation of hostilities, cotton production regained the ground lost during the war, and the utilization of the enormous waste represented by the seed became a subject of renewed interest. With the prospect of millions of tons of raw material produced without the cultivation of a single additional acre of land, without the employment of additional labor, or the investment of additional capital over and above that required for the production of the staple, cotton, the utilization of the seed presented an alluring field for exploitation. A few mills were erected late in the sixties, equipped with hydraulic presses identical with those then in common use in the North for the expression of oil from flaxseed. Probably the utilization of waste was the most active principle underlying the early experiments. Contrary to what had been the case with linseed oil, no important domestic demand preexisted for the cotton-seed product. Unadapted to general illuminating and lubricating purposes, deficient in the drying properties essential to its use in paint, its edible properties unknown, its sphere of usefulness seemed limited. Interest became centered in the export trade. The foreign demand increased with each successive year, and soon became the chief support of the new industry. In 1879–80 the quantity of cotton-seed oil manufactured in the United States had increased to about 9,000,000 gallons; and the importance of the export trade was apparent in the fact that almost 7,000,000 gallons were shipped abroad against a little over 2,000,000 gallons consumed at home.

In the following year the discovery was made that cotton-seed oil mixed with certain animal fats made an acceptable and valuable

substitute for lard. This gave an immediate impetus to the industry and eventually resulted in making it one of the most important industries of the Southern States. A domestic demand sprang up that absorbed practically the entire output of the then existing mills, and foreign trade, as a result of the active domestic competition, dwindled to insignificant proportions. In 1881–82 the output of cotton-seed oil increased to about 12,000,000, and 1882–83 to about 15,000,000 gallons. Of these quantities, 11,000,000 and nearly 15,000,000 gallons, respectively, were taken by the home trade. The combined exports of the two years amounted to only 1,129,160 gallons. From the date of this discovery began a period of activity in this industry that has continued almost without abatement up to the present day. New mills were constructed year after year throughout the South until they now number upwards of 600. The quantity of cotton seed utilized, which, previous to 1881, had never amounted to one-tenth of the total crop, has increased until fully 60 per cent of the average crop is now converted into valuable products; this, too, notwithstanding the fact that the production of cotton seed has meanwhile increased in about the same proportions. New uses found from time to time for cotton-seed oil have given additional stimulus to both foreign and domestic demand. A few years after the decline in the export trade in 1882 it was restored to its old proportions. Meanwhile the domestic trade, primarily as a result of the demand from packing houses, was increasing by leaps and bounds. By 1893–94 exports had increased to 15,000,000 gallons; the domestic demand in the same year absorbed about 40,000,000 gallons.

Between 1894–95 and 1902–1903 the production of cotton-seed oil in the United States was doubled. In the former year arose a greatly increased demand for this product in Europe; in 1898–99 it culminated in exports of upwards of 50,000,000 gallons, domestic demand in the meantime averaging about 40,000,000 gallons. This remarkable increase in the foreign trade attracted to the industry new capital and enterprise and resulted in a period of the greatest activity in the erection of mills known in its history. Since 1898–99 exports have declined irregularly, and in the fiscal year 1902–1903 they amounted to only 35,642,994 gallons. But the manufacture of oil has increased steadily, and is estimated to have amounted in 1902–1903 to a total of from 110,000,000 to 115,000,000 gallons. Of this enormous output, the domestic demand absorbed from 75,000,000 to 80,000,000 gallons.

THE PRODUCTION OF FLAXSEED AND COTTON SEED.

The production of flaxseed and cotton seed—the two crops practically constituting the oleaginous-seed crop of the United States—now aggregates annually upwards of 5,500,000 tons. It is estimated that with every 500-pound bale of cotton picked there is gathered one-half

ton of seed, and hence a cotton crop of 10,000,000 bales indicates a production of 5,000,000 tons of cotton seed. The average annual production of flaxseed for the past five years has been about 672,000 tons. A 10,000,000-bale cotton crop and an average production of flaxseed therefore result in an output of 5,672,000 tons of oleaginous seed.

Although statistics upon the production of the many varieties of oleaginous seeds in the principal producing countries are incomplete, there is no doubt that the production of the United States exceeds the combined crops of any other two countries in the world. It is true that not all of the United States crops is utilized for oil-making purposes. Probably not over 60 per cent of the cotton-seed crop finds its way to the oil mills, and of late years there has been an overproduction of flaxseed. But, assuming that 3,000,000 tons of cotton seed are now annually converted into oil, and, putting the average quantity of flaxseed crushed annually during the past five years at 500,000 tons, the total crush of these seeds may be conservatively estimated at 3,500,000 tons. Whether considered separately or collectively, these figures indicate that the United States stands first among all countries as a manufacturer of oil as well as a producer of oleaginous seeds.

BRITISH INDIA AND RUSSIA AS PRODUCERS OF OLEAGINOUS SEEDS.

Next to the United States, British India and Russia are the most important producers of oleaginous seeds; British India of rape seed, mustard seed, sesamum, flaxseed, poppy seed, cotton seed, and a great variety of other oleaginous seeds and oil-yielding nuts; Russia chiefly of flaxseed, hemp seed, sunflower seed, and rape seed. Both countries are also manufacturers of oil, Russia especially on a scale of considerable importance; but the scope of their industrial operations is not capable of statistical expression. Excepting Russia, the great centers for the manufacture of oil from oleaginous seeds, outside of the United States, are the countries of northwestern Europe. And, since oleaginous seeds are not produced in those countries on an extensive scale, the magnitude of their industrial operations in this line and of their consumption of the products of such seeds may be indicated in a general way by their import trade.

COUNTRIES IMPORTING AND EXPORTING OIL-PRODUCING SEEDS AND NUTS.

THE UNITED KINGDOM.

The United Kingdom is the heaviest importer of oleaginous seeds in Europe and, next to the United States (and possibly Russia), the most important manufacturer of oils from these products in the world. The English demand, unlike that of most other European countries, is

chiefly for cotton seed and flaxseed. For the former, Egypt and British India are the almost exclusive sources of supply. Until within the last two or three years practically the entire imports of cotton seed were drawn from Egypt, but, stimulated by recent high prices, an important trade with British India has been established, and in 1903 about one-third of the English supply was drawn from that source. For flaxseed there are but four important sources of supply in the world—Argentina, British India, Russia, and the United States; and though the English trade derives supplies from all these sources, the bulk of trade is ordinarily from Argentina and British India, Russia seldom furnishing as much as 10 per cent of the total imports, and the United States as a general rule a smaller proportion. The rape seed imported into the United Kingdom comes principally from British India and Russia. Below is given a statement which shows the net imports (that is, the total imports less the reexports) into the United Kingdom of cotton seed, flaxseed, rape seed, and oil-yielding nuts each year from 1897 to 1902. In the official publications of the British Government the imports of flaxseed and rape seed are given in imperial quarters or units of measure; the other imports are stated in tons or units of weight. For convenience of comparison units of measure have here been reduced to units of weight by somewhat arbitrarily estimating a quarter of flaxseed to be equivalent to 8 bushels of 56 pounds each, and a quarter of rape seed to 8 bushels of 52 pounds each.

Net imports of oleaginous seeds and nuts into the United Kingdom.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Cotton seed	1,233,388,800	979,213,760	910,510,720	801,946,880	964,167,680	924,842,240
Flaxseed	744,305,408	678,502,272	684,793,536	766,620,288	693,119,616	818,514,816
Rape seed	79,260,480	61,528,896	46,640,256	74,296,352	97,367,296	67,096,640
Nuts and kernels for expressing oil therefrom	129,884,160	112,101,600	126,936,320	128,056,320	115,610,880	121,434,880
Total	2,186,838,848	1,831,346,528	1,768,880,832	1,770,919,840	1,870,265,472	1,931,888,576

In addition to the above totals, there has been an average net import for the six years of 842,576 bushels of "seeds, not enumerated, for expressing the oil therefrom." These quantities obviously not being convertible into terms of weight, on account of a lack of knowledge of the varieties of the seeds and the proportion each variety forms of the whole, it can only be said in a general way that the mills in the United Kingdom crush annually upwards of 1,000,000 tons of oleaginous seeds, against an estimated crush in the season of 1902–1903 of about 3,500,000 tons in the United States.

FRANCE.

France for the past few years has imported annually between 700,000 and 800,000 tons of oleaginous seeds and nuts, and as an importer of these products ranks second only to the United Kingdom.

The most interesting feature of the French trade is the heavy imports of peanuts, both shelled and unshelled. The unshelled peanuts are imported chiefly from the west coast of Africa, 70 per cent of them from the French colony of Senegal, where peanuts are the principal and almost the only crop. They are shipped from Senegal only in cargo lots, and the trade is monopolized by French houses, to whom buyers in other countries must look for their supplies of this variety. The shelled product is from the French and British Indies, and is imported in a shelled state because of the risk of deterioration from climatic causes in passage through the Red Sea. Formerly unshelled peanuts from Africa constituted the bulk of the French supply, but in recent years the trade with the East Indies has increased rapidly, and in 1902 filled the greater part of the demand. The greatest market for these products, not only in France, but in the world, is the city of Marseilles, where large quantities are annually converted into oil, the higher grades for edible uses, and the lower for manufacture into soap and for other industrial purposes. Next to peanuts as to the quantities imported is flaxseed, of which British India and Argentina combined supply about 80 per cent, ordinarily in about equal proportions. Third in importance is copra (dried meats of the cocoanut), of which the chief sources of supply are the British and Dutch Indies and the Philippine Islands. Smaller quantities are also imported from the French Indies, the European possessions in Africa, and other sources. The oil from this product is used in France to a limited extent as a substitute for butter; but, on account of its tendency to become rancid very readily, it is generally used for industrial purposes, such as the manufacture of perfumery, soap, etc.

Of the great variety of oleaginous seeds imported into France, three others are especially conspicuous because of their volume—sesamum, mustard, and cotton seed. For sesamum, the British Indies is the chief and for mustard the almost exclusive source of supply. The cotton-seed oil mills of France are run, as were formerly those in England, almost entirely on seed imported from Egypt, supplemented with small quantities from the United States, Turkey, and a few other sources. A new feature has been introduced into this trade, however, within the past two years by the annual importation of about 16,000,000 pounds from the British Indies. Colza, rape seed, and ravison produce oils of similar properties, used chiefly for illuminating and lubricating purposes. They are produced on an extensive scale in some sections of southeastern Europe, whence France draws the principal

part of her supplies. The bulk of the imports of colza and rape seed are from Roumania, and of ravison from Russia. And the magnitude of the manufacturing industries which depend upon these three products may be measured by the fact that their combined imports exceed in quantity the total imports of cotton seed. The only other oil seeds of European production imported into France are hemp seed and black poppy seed, the former chiefly from Russia and Austria-Hungary, and the latter, though in very small proportions, exclusively from Belgium.

Of the nuts imported into France for oil-making purposes, the most important, after peanuts, is the palm kernel, the oil from which is used for the manufacture of wax candles and of soap. The palm from which is derived the fruit of which this product is a seed is common on the tropical part of the west coast of Africa, and from that source France draws her entire supply. Other nuts imported in quantities deserving special mention are touloucouna, mowra, and illipe, all products of British India.

The following statement shows the imports of oleaginous seeds and nuts into France for home consumption each year from 1897 to 1902. The original figures as published by the French Government are in kilograms, which have been here reduced to equivalents in pounds.

Imports of oleaginous seeds and nuts into France.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
Peanuts:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Unshelled	231,362,413	265,434,299	296,003,983	208,324,669	206,536,291	135,452,238
Shelled	263,345,186	128,158,294	53,562,915	25,985,005	10,502,966	15,342,261
Flaxseed	225,549,464	240,545,536	231,086,800	281,210,440	246,177,344	313,016,088
Sesamum	183,893,728	162,679,378	153,637,846	169,371,933	151,398,676	119,549,314
Colza	25,594,657	10,676,809	33,105,308	2,528,685	4,242,687	12,269,064
Black poppy seed	27,919	129,271	129,840	113,180	59,068	55,953
Mustard seed [a]	133,429,460	172,105,395	66,113,776	142,697,402	167,131,775	118,857,008
Rape seed	73,734,074	49,201,418	99,653,495	4,332,894	9,516,017	25,233,256
Ravison	14,064,730	12,197,210	27,126,457	35,792,988	45,447,880	58,890,563
Cotton seed	103,526,885	98,650,277	110,505,701	100,233,488	124,246,199	116,880,822
Niger seed	5,024,847	333,600	324	7,331,993	755,949	251
Hemp seed	22,829,319	12,105,549	17,468,329	25,367,841	12,300,537	11,684,193
White poppy seed	62,412,949	58,410,864	48,309,245	57,457,205	39,275,948	53,437,549
Copra	202,721,560	178,725,191	233,911,583	182,994,390	153,115,888	150,076,487
Palm kernels	18,873,891	19,608,475	18,287,627	17,124,755	28,597,921	24,151,327
Touloucouna, mowra, and illipe	27,897,500	13,631,020	10,623,222	29,844,982	22,776,935	11,884,818
All other oil seeds	74,239,013	69,375,186	40,887,360	68,599,789	51,862,693	67,709,673
Total	1,668,527,595	1,491,967,772	1,440,413,811	1,359,311,639	1,273,944,774	1,234,490,865

[a] Includes red and white colza from India.

The production of oleaginous seeds in France has declined in recent years, and is now of small importance. The following shows the total

production, by varieties, from 1897 to 1901, the latest date for which statistics have been issued:

Production of oleaginous seeds in France.

Seeds.	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Colza	83,628,000	93,765,000	136,722,000	140,707,000	126,323,000
Rape seed	6,691,000	7,753,000	11,415,000	11,796,000	12,266,000
Black poppy seed	9,432,000	13,672,000	16,319,000	17,960,000	17,823,000
Cameline	452,000	617,000	538,000	631,000	912,000
Hemp seed	17,586,000	18,957,000	18,744,000	19,424,000	20,960,000
Flaxseed	34,215,000	27,591,000	19,333,000	19,995,000	29,335,000
Total	152,004,000	162,355,000	203,071,000	210,513,000	207,619,000

The imports for home consumption, plus the native production, give the total French supply of oleaginous seeds. Practically, this entire supply, excepting, of course, small quantities of some varieties, such as mustard, etc., that are used for other than oil-making purposes, is manufactured into oil in the French mills. There is a small export trade, it is true, in native-grown seeds; and, although in the official statements of domestic exports there are included those imported seeds and nuts which have been "nationalized"—that is, changed by French labor (such as by cleaning, decortication, etc.) from the state in which they were originally imported—the total export trade in both native and "nationalized" seeds is comparatively unimportant. It never diminishes the total supply by more than 3 or 4 per cent.

The total "domestic" exports of peanuts, linseed, and cotton seed, varieties of most interest in the United States, together with the aggregate of other oil seeds, is given below for each year from 1897 to 1902:

Exports of oleaginous seeds and nuts from France.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Peanuts:						
Unshelled	14,790,081	16,014,045	15,303,687	12,723,825	13,122,454	2,973,274
Shelled	4,978,530	2,843,037	4,908,119	8,135,250	7,520,901	8,917,035
Flaxseed	6,462,349	23,741,897	15,284,346	3,387,002	6,070,686	7,162,810
Cotton seed	1,724,637	....	1,287,922	3,086,350	29,823	653
All other oil seeds and nuts	13,352,260	19,404,918	11,799,756	7,986,005	12,415,281	8,071,305
Total	41,307,857	62,003,897	48,583,830	35,318,432	39,159,145	27,125,077

GERMANY.

The German trade in oleaginous seeds is also almost exclusively an import one. The domestic cultivation of these products has declined greatly in recent years, as was the case in France. Statistics of production are not published, but the area sown to oil seeds was found at the last official investigation in 1900 to amount to only 285,925 acres, divided as follows: Rape and colza, 179,731; cameline,

2,465; poppy, 8,091; mustard, 3,717; flax, 83,180; and hemp, 8,741. The total area was slightly larger than that in France, which in the same year was officially given at 246,544 acres. It is evident that the oil-making industries of Germany depend almost entirely upon foreign supplies. The imports for the past few years have exceeded 700,000 tons annually, making Germany as an importer a close second to France.

The varieties of oil seeds imported into Germany are distinguished from those imported into France, in that they consist to a larger extent of seeds that yield industrial oils. Flaxseed, rape seed, and colza constitute over half the German imports. As cotton seed is quantitatively first in the imports of oil seeds into the United Kingdom and peanuts first in France, so flaxseed is in quantity the most important oil-yielding product imported into Germany. Next to the United Kingdom, this country is the heaviest consumer of flaxseed among the importing countries of Europe. The German demand for industrial oils is also reflected in the fact that the annual imports of colza and rape seed are almost double the imports of the like products into France and the United Kingdom combined. Russia was formerly the chief source of supply for flaxseed, but Argentina and British India now each hold a larger share of the trade. In 1902, 993,513 bushels were imported from the United States. Over half of the supply of colza and rape seed is imported from British India, the remainder chiefly from Roumania, Russia, and Austria-Hungary.

Next in importance to the combined imports of flaxseed, colza, and rape seed are the rapidly increasing imports of palm kernels and copra. The imports of these products have increased almost 60 per cent in the past six years. They are drawn mostly from the same sources as are the supplies of the same products by France. The following gives the imports of oleaginous seeds for home consumption into Germany, by varieties, for the six years 1897 to 1902:

Imports of oleaginous seeds and nuts into Germany.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Peanuts	56,531,800	42,073,006	44,373,528	31,008,449	28,166,470	33,483,359
Poppy seed	68,646,418	57,142,258	63,380,678	61,687,087	55,932,803	50,677,646
Rape, colza, etc.[a]	331,989,398	361,738,175	290,819,626	232,193,876	265,295,083	264,764,961
Mustard seed	12,309,066	11,680,748	10,941,319	8,446,789	8,434,883	7,909,082
Sesamum	109,829,198	79,079,350	65,337,280	85,474,959	68,856,298	46,349,532
Sunflower and other oil seeds not named	6,155,525	1,793,239	6,810,519	4,615,155	4,895,143	5,476,281
Cotton seed	33,516,207	13,659,398	7,675,611	2,295,673	3,873,080	1,997,388
Flaxseed	542,248,616	522,340,896	589,893,752	586,471,536	595,129,528	578,171,384
Palm kernels, copra, shea nuts, etc	407,564,500	332,979,714	328,394,982	282,395,513	254,403,899	257,919,669
Castor beans	5,556,530	4,345,090	2,287,736	3,446,045	2,028,693	868,400
Hemp seed	24,561,691	15,212,332	14,413,378	26,478,392	10,706,085	13,095,896
Total	1,598,908,952	1,445,044,206	1,424,328,409	1,324,513,504	1,297,721,965	1,260,713,538

[a] Includes hedge mustard and radish.

The imports of oil seeds into Germany represent closely the quantities of these products consumed in the oil mills of that country. The exports, as compared with the total supply, are of small proportions. As is the case in the official statements of the commerce of France, and from a like cause, the official figures of exports of domestic oil seeds from Germany include products that are plainly of colonial and foreign origin. The total of such exports, however, reduces the supplies of seeds available for manufacture in German mills by less than 5 per cent annually. The table following gives the total exports of domestic oil seeds from Germany, peanuts, flaxseed, and cotton seed stated separately, for the past six years:

Exports of oleaginous seeds and nuts from Germany.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Peanuts	4,850	1,644,269	29,983	1,764	661	1,543
Flaxseed	15,607,144	20,125,112	38,241,616	21,659,514	17,871,784	46,147,136
Cotton seed	4,409	84,217	2,425	31,085	1,102	....
All other	38,374,787	33,560,959	18,817,109	39,108,451	21,825,536	26,216,263
Total	53,991,190	55,414,557	57,091,133	63,800,844	39,699,083	72,364,942

HOLLAND.

The imports of oleaginous seeds into Holland, officially given as for home consumption, usually amount to from 325,000 to 350,000 tons a year. This supply is not supplemented to any great extent by domestic production. In the official agricultural statistics for 1900 returns were made on only two oil-seed crops—flax and hemp. The area sown to the former was given at only 28,259 acres and to the latter at 299 acres. Rape seed is also cultivated, the average annual area from 1891 to 1900 being officially given at 12,889 acres. It is evident that the domestic production of oil seeds contributes little to the supply. About half of the quantities of oil seeds imported into Holland for home consumption, however, are exported as the produce of the Kingdom, the custom being, as in France and Germany, to classify as domestic exports all imported goods upon reexportation that have been changed in condition in any way by native labor. The exports of domestic seeds, as thus officially stated, usually amount annually to from 150,000 to 175,000 tons. The quantity of imported oil seeds actually retained for home consumption rarely ever exceeds 175,000 tons a year.

The linseed-oil industry is the most important industry of this class in Holland, its principal center being the city of Amsterdam. Flaxseed constitutes over half of the total of oil seeds of all kinds imported for home consumption. There is, however, a considerable export trade, but the annual supply of imported flaxseed retained for manufacture in the domestic oil mills amounts normally to from 130,000 to 140,000 tons a year. This quantity is increased, of course, to a very limited extent by seed of native production. Russia and British India

formerly furnished the bulk of the flaxseed, but in recent years Argentina has become the chief source of supply. Holland is also one of the most important customers in Europe for flaxseed grown in the United States. In 1902, according to the statistics of that Kingdom, imports of flaxseed from the United States amounted to 1,884,659 bushels, being second only to those from Argentina, which were 2,546,764 bushels.

The only other oil seeds imported into Holland which furnish the bases of considerable industries are colza and rape seed, under which classification are also included all other oil seeds not specially designated. The excess of the imports over the exports of those products amounted in 1902 to upward of 33,000 tons, which closely represents the present extent of their manufacture in the Kingdom.

Copra is an article of growing commercial importance in Holland. It is imported almost exclusively from Java and other Dutch possessions in the East Indies. The bulk of the imports for home consumption, however, figures again in the exports of home produce, and formerly only from 1,500 to 2,000 tons annually were actually retained for national consumption. In recent years the quantities imported have greatly increased; the utilization of this product in the manufacture of a substitute for butter has also enlarged the domestic demand, and from 5,000 to 10,000 tons now annually enter into home consumption. The following tables show in detail the imports of oleaginous seeds into Holland and exports therefrom (special commerce), each year, from 1897 to 1902:

Foreign commerce in oleaginous seeds and nuts in Holland.

IMPORTS.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Mustard seed	4,142,690	1,724,690	3,140,424	2,821,400	1,346,018	1,589,860
Copra	103,549,778	54,187,465	55,854,147	37,426,388	14,796,746	31,337,000
Colza, rape seed, etc.[a]	153,337,236	119,404,272	128,405,160	77,605,424	52,496,080	82,653,932
Flaxseed	434,497,224	384,637,904	407,684,480	472,736,944	488,596,304	513,740,024
Hemp seed	4,481,444	3,439,612	13,199,428	18,002,160	8,067,752	8,247,184
Palm kernels	55,169,277	57,911,642	55,776,231	52,180,430	48,761,790	56,277,434
Total	755,177,649	621,305,585	664,059,870	660,772,746	614,064,690	693,845,434

EXPORTS.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Mustard seed	8,824,801	6,729,212	9,129,631	6,598,688	5,463,300	5,211,682
Copra	82,114,355	43,373,828	52,064,341	34,377,321	10,784,128	28,720,625
Colza, rape seed, etc.[a]	85,564 316	58,809,669	80,823,885	29,750,450	34,699,314	39,198,984
Flaxseed	163,228,724	164,731,177	195,390,327	202,289,919	196,860,901	244,402,848
Hemp seed	984,255	436,590	773,866	1,154,220	476,198	482,150
Palm kernels	52,608,836	50,559,752	54,852,824	44,918,403	44,517,321	55,757,458
Total	393,325,287	324,640,228	393,034,874	319,089,001	292,801,162	373,773,747

[a] Includes other oil seeds not especially designated.

BELGIUM.

The average annual imports of oleaginous seeds and nuts into Belgium for home consumption for the five years, 1898 to 1902, have been about 270,000 tons. This supply is not materially increased by domestic production; the annual crop of flaxseed amounts to only from 10,000 to 12,000 tons, and other oil-seed crops are of comparatively negligible proportions. The total available supply, as represented by imports for home consumption and the domestic crops, is, however, greatly reduced by exports. The annual average exports of domestic seeds and imported seeds exported as domestic produce have amounted for the five years, 1898 to 1902, to about 150,000 tons. The average consumption of oleaginous seeds and nuts of all kinds in Belgium, therefore, probably does not much exceed 130,000 tons annually. In the official statements of exports two varieties only are separately stated, the others being given under a general classification. The following tables show the commerce in oil seeds in Belgium, as represented by the official figures on imports for home consumption and exports of domestic production from 1897 to 1902:

Foreign commerce in oleaginous seeds and nuts in Belgium.

IMPORTS.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Palm kernels	3,487,861	1,089,175	1,321,273	3,419,798	2,607,408	440,895
Peanuts	5,295,513	16,646,358	13,238,633	4,877,964	3,772,158	11,730,770
Other oil seeds	590,312,673	510,883,275	396,276,457	589,487,246	567,845,922	426,514,985
Total	599,096,047	528,618,808	410,836,363	597,785,008	574,225,488	438,686,650

EXPORTS.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Palm kernels	1,712,913	263,196	1,492,398	724,158	1,191,939	464,970
Peanuts	1,818,783	5,950,757	4,684,471	151,391	900,373	3,131,963
Other oil seeds	301,167,549	287,455,364	219,133,176	287,914,033	328,977,448	183,008,293
Total	304,699,245	293,669,317	225,310,045	288,789,582	331,069,760	186,605,226

DENMARK.

Denmark, like Belgium and Holland, is a producer of oleaginous seeds only on a small scale. The consumption of these products can, therefore, be closely measured by the foreign commerce. The principal oil seed imported is flaxseed, of which the annual consumption usually amounts to from 15,000 to 20,000 tons. There has been, however, a rapidly increasing import trade in palm kernels and copra, and the consumption of these products has increased from about 1,600 tons in 1897 to almost 10,000 tons in 1902. The following table gives

by varieties the net imports (that is, the total imports minus the total general exports) of oleaginous seeds and nuts into Denmark each year from 1897 to 1902:

Net imports of oleaginous seeds and nuts into Denmark.

Seeds and nuts.	1902	1901	1900	1899	1898	1897
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Flaxseed	31,569,872	28,360,122	32,709,543	34,604,685	35,329,767	39,982,820
Hemp seed	2,502,221	2,084,265	1,338,230	312,307	351,333	345,582
Rape seed	9,744,332	9,755,329	9,432,552	9,499,259	7,359,630	12,290,691
Palm kernels and copra	19,554,802	14,255,376	9,726,332	10,914,449	4,290,974	3,393,446
Other oil seeds	15,873,120	17,794,284	11,937,828	11,032,771	6,846,102	2,796,508
Total	79,244,347	72,249,376	65,144,485	66,363,471	54,177,806	58,809,047

CONSUMPTION OF OIL SEEDS BY SIX IMPORTING COUNTRIES.

The movement of oil seeds into the six countries whose commerce in these products is outlined above embraces by far the greater proportion of the total movement into all the importing countries of Europe. To these centers converges the bulk of the surplus oleaginous-seed crops of the world. Confusing duplications, which are generally inseparable from statistics of commercial movements among nations, prevent exact and detailed deductions, but in a general way it is apparent that the consumption of these products by the six countries combined now amounts annually to about a round 3,000,000 tons; in other words, less by a half million tons than the quantities of cotton seed and flaxseed annually used in manufacture in the United States.

RECENT PROGRESS IN TIMBER PRESERVATION.

By Hermann von Schrenk,
In Charge of Forest Products, Bureau of Forestry.

INTRODUCTION.

During the past year interest in the subject of timber preservation has grown throughout the United States. At the present time there are no less than six large preserving plants under construction or under consideration. The increasing difficulty experienced in getting high-grade timbers, as well as the increasing prices of such timbers, has brought the question of the preservation of woods of lesser resisting powers to the front. In the past the long-lived timbers, like white oak, longleaf pine, and cedar, were employed wherever resistance to decay was an important requisite. As long as these timbers were available in large quantities, it proved most economical to use them. Now that they are much more difficult to get, and consequently more expensive, the question is frequently asked: Is it practicable to use timbers which are not as resistant to decay, but which can be treated chemically; and, if so, what does it cost to treat them, and what length of life is it possible to get?

It is a matter of great importance to all users of timber to know (1) what timbers they can use; (2) how large the supply is; and, (3) how the poorer timbers, when once they are available, can be made more or less decay proof. This subject will therefore be considered from these three standpoints.

TIMBERS WHICH CAN BE TREATED.

Of the inferior timbers, that is, timbers of less decay-resisting powers, which it will probably pay to treat in one way or another, the following is a provisional list:

Some timber trees susceptible of preservative treatment.

NORTHERN AND EASTERN UNITED STATES.	CENTRAL UNITED STATES.	WESTERN UNITED STATES.
Maple.	Red and swamp oaks.	Tamarack.
Beech.	Beech.	Lodgepole pine.
Birch.	Hemlock.	Red fir.
Hemlock.	Tamarack.	Hemlock.
Loblolly pine.	Gum.	Yellow pines.
Red oak family.	Loblolly pine.	True firs.
North Carolina pine.	Cottonwood.	

These timbers are, as a rule, somewhat porous, and consequently, when properly prepared, will allow of a more or less complete penetration of a preservative solution. A large number of them grow with great rapidity and are therefore desirable trees to encourage in any plan involving forest management. Success in the use of any or all of the so-called inferior woods will depend almost entirely on the manner in which they are handled. It is absolutely safe to say to-day that, with proper preliminary preparation and proper treatment with a preservative, any and all of the timbers referred to above can be made to withstand decay for longer or shorter periods, depending upon the kinds of preservatives used.

Attention should be called to the statement that these timbers "will withstand *decay*." Preservative treatment will not protect a timber against *mechanical abrasion*. Red oak or loblolly pine treated with creosote will last indefinitely in the form of a fence post or telegraph

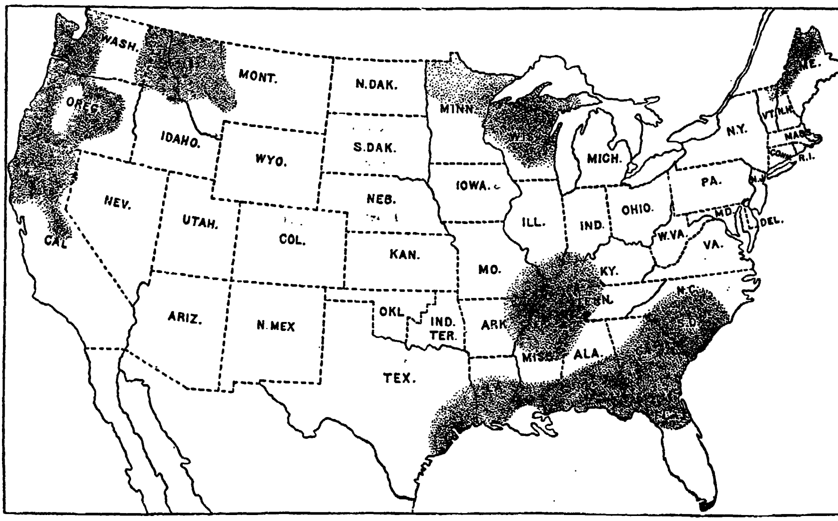

FIG. 46.—Distribution of large sources of timber supply.

pole, but both these timbers will wear out in the form of a railroad tie after a short period unless devices to protect their fibers are adopted. In other words, preservative treatment, as we know it to-day, protects against decay but not against mechanical abrasion.

SUPPLY OF INFERIOR TIMBERS AVAILABLE.

An important consideration which will determine to a large extent whether timber preservation will be practiced, relates to the probable supply of such timbers. While it is not possible to give accurate figures as to the supply of any one timber, it is possible to point out in a general way where the great centers of forest wealth are. A glance at the map (fig. 46) will show this. In the New England States

we can count on considerable quantities of birch, balsam fir, and maple. In the central Mississippi Valley there are large quantities of inferior oaks, beech, and gum. In the South the inferior pines have hardly been touched, while in Wisconsin and Minnesota the tamarack and hemlock are available in large quantities. In the Northwestern States, hemlock, red fir, tamarack, and true firs are found in great abundance. It appears therefore that there are still at hand large supplies of the inferior timbers, and that the centers of supply are widely distributed over the country.

Having found which timbers can be used, it becomes necessary to determine what will constitute a proper preparation for treatment.

HOW TO PREPARE INFERIOR WOODS FOR TREATMENT.

The object of a preliminary preparation for treatment is to make the wood as porous as possible. Most of the woods classed as inferior are more or less open grained, and for this reason are far better suited to preservative treatment than the high-grade timbers, which are denser. Freshly cut wood is full of water, contained largely in cell walls of the wood fiber. In addition to water the wood fibers of the sapwood contain certain small quantities of starches, sugars, albuminous substances, etc. Without going into details (discussed in full in Bulletin No. 41, Bureau of Forestry), it may be said that wood in which these substances are present is rendered less permeable by their presence, that is, most preservatives will not penetrate wood which is wet and full of organic matter. It has been found that the easiest way to make wood more permeable for preservatives is to season it thoroughly, either by ordinary air seasoning or by kiln drying.

The wood should be cut, so far as possible, in the winter period, that is, between October and March. Where possible the bark should be removed, which will not only hasten the seasoning, but will also lessen, if not prevent, insect attack. After the wood has been cut it should be piled in such a way as to allow the greatest amount of air circulation between the various pieces. This holds good whether the wood be for fence posts, telegraph poles, or railroad ties, or is in the form of sawed lumber. During the seasoning process not only does the water evaporate from the timber, but the various starches and albuminous substances are broken down, correspondingly increasing the penetrability of the wood.

The method of piling will depend largely upon the prevalent climatic conditions. In general, however, in extremely dry countries the timber will have to be piled more closely than in rainy countries, to prevent the too rapid drying out and consequent checking of the wood. In rainy countries excellent results have been obtained by building piles so that the upper pieces form a roof. Pl. LIII gives two illustrations of such piling, fig. 1 showing a pile of lumber in a French lumber yard,

and fig. 2 a pile of Baltic pine ties near Berlin, so constructed as to shed the greatest possible amount of water. Pl. LIII, fig. 2, also shows a very useful way of piling timbers in climates where there is a great deal of moisture in the air. This would be applicable in the Gulf States. It will be noted that very little room is taken up, and at the same time the individual pieces of timber touch at very few points, thus permitting air circulation on all sides of the wood. Pl. LIV shows (fig. 1) the best method for piling timber to season it rapidly, and (fig. 2) the simplest and most effective manner of piling telephone poles.

The length of time which is necessary to air-season wood varies with the climate and the season of the year. The tables following and the diagrams (figs. 47 and 48) show this graphically. The curves in the

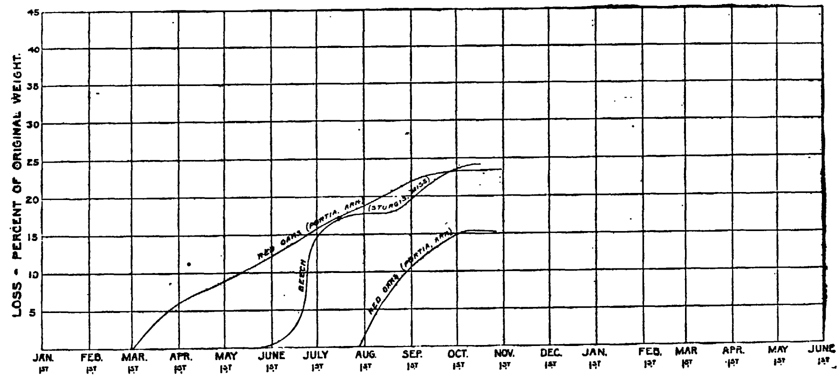

FIG. 47.—Rate of seasoning of red oak.

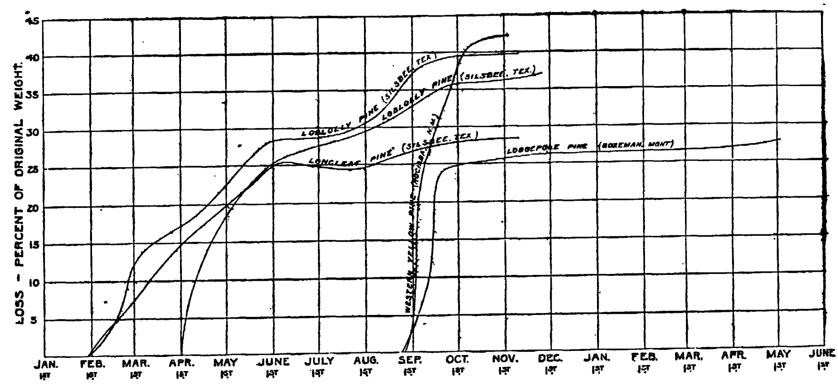

FIG. 48.—Rate of seasoning of loblolly, longleaf, and lodgepole pines.

diagrams show the rate of seasoning during the past year of red oak timber in Arkansas, loblolly and longleaf pines in Texas, and lodgepole pine in Montana.

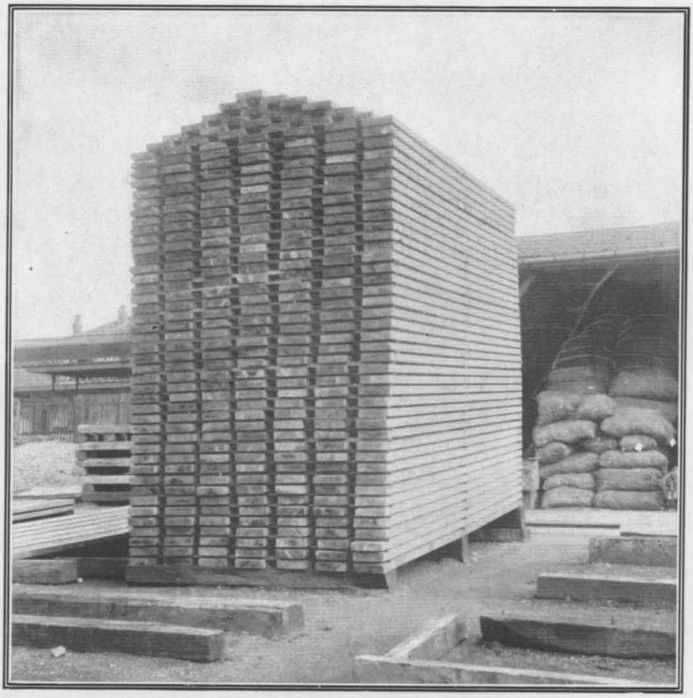

FIG. 1.—LUMBER PILED TO SHED WATER—FRANCE.

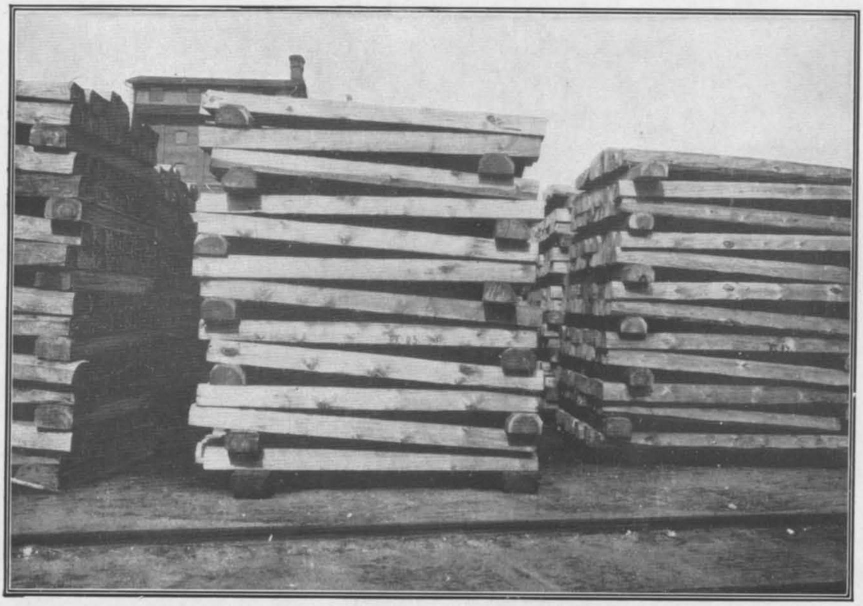

FIG. 2.—BALTIC PINE TIES PILED TO SHED WATER—GERMANY.

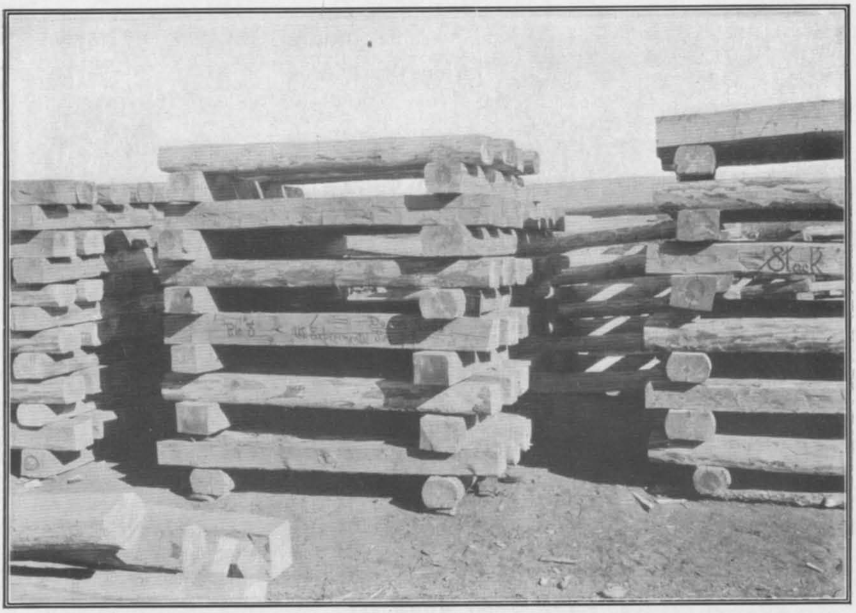

FIG. 1.—HOW TO PILE TIMBER TO SEASON IT RAPIDLY.

FIG. 2.—METHOD RECOMMENDED FOR PILING POLES.

Weights at successive dates of red oak ties cut in June, 1903, at Portia, Ark.

Date of weighing.	Average weight per tie.	Loss.
	Pounds.	*Per cent.*
June 30	181.5	....
July 18	172.4	6.6
July 28	170.58	7.5
September 10	162.09	12.1
September 20	154.75	16.1
October 28	154.35	16.3

In central New Mexico, where the climate is very dry and hot during the summer, timber dries with great rapidity, as indicated in the following tables:

Weights at successive dates of red pine ties cut in August, 1903, at Rociada, N. Mex.

Date of weighing.	Average weight per tie.
	Pounds.
August 18	184.0
September 3	124.8
September 18	112.1
October 9	107.5
November 5	106.4

Per cent of loss November 5, 42.2.

Weights at successive dates of black pine ties cut in August, 1903, at Rociada, N. Mex.

Date of weighing.	Average weight per tie.
	Pounds.
August 26	164.8
September 3	127.8
September 18	103.0
October 9	96.0
November 6	93.7

Per cent of loss November 6, 43.1.

The cost of holding wood while seasoning is at best a very small one, and in view of the very much improved treatment possible when wood is seasoned this cost need hardly be considered.

TREATMENT OF TIMBER.

The treatment of wood falls into several classes, according to the manner in which the preservative is applied.

Where but few pieces are to be treated, the preservative is often applied to the outside of the wood, either with a brush or by dipping into the preservative. When wood is absolutely dry it will, in many instances, absorb in this way sufficient quantities of preservatives

having any penetrating power, such as tar oils, spirittine, carbolineum, etc. These substances are excellent preservatives, and can be used to protect fence posts, car lumber, sills, and other structural timbers. Great care must be taken, however, that the wood is absolutely seasoned. All tar-oil products should be applied hot. Of the numerous products now being sold, for which the claim is made that they preserve wood absolutely by painting, only a very small number are of any value. Spirittine, carbolineum, and ordinary gas tar may be counted on as excellent wood preservers.

CORROSIVE SUBLIMATE.

The corrosive sublimate method of treating timber consists in immersing the wood in a solution of mercuric chlorid for a period sufficiently long to permit of more or less thorough penetration of the preservative. Excellent results have been obtained by soaking wood in a solution of corrosive sublimate (mercuric chlorid). This process has been extensively used in Europe for many years, particularly for smaller pieces of wood, such as posts, stakes, boards, etc.

The method of operation is extremely simple, and the original cost of the necessary apparatus is very small. A tank or vat is constructed of thick planks, carefully joined together so as to make the tank watertight. No iron must be used in building this vat, since it is quickly destroyed by the mercuric chlorid solution. The wood to be treated, which ought to be seasoned, is piled in this vat, and when the latter is almost full, by means of a series of clamps the wood is held firmly in position. Pl. LV, fig. 1, shows such a tank, into which telephone poles are to be piled. The corrosive sublimate solution is then run in through wooden pipes from a neighboring storage tank, made also of wood. The solution is made by using one part of sublimate to 150 parts of water, the salt being first dissolved in a small quantity of hot water and then diluted to the proper point. The strength of the solution decreases as it is used, and must, therefore, be renewed by adding more sublimate from time to time. The liquid should stand in the vat so that it covers the wood at least an inch. As light affects the solution, it must be kept out by some sort of roof. The wood is left in the vats for from five to ten days, according to the size of the timber. Time should be given for thorough absorption by the wood before it is removed. After the solution has penetrated for a sufficient distance into the timber, the wood is taken out and dried. As the sublimate is comparatively insoluble in water, it remains in the timber for a very much longer time than salts like copper sulphate or zinc chlorid.

Wood treated in this way can be employed with comparative safety for fence posts, stakes for grapevines, etc. The cost of treatment is about 4½ cents per cubic foot of wood. In view of the small expense involved in putting up an apparatus to treat with this process, and the comparatively good results obtained, it is somewhat surprising that it

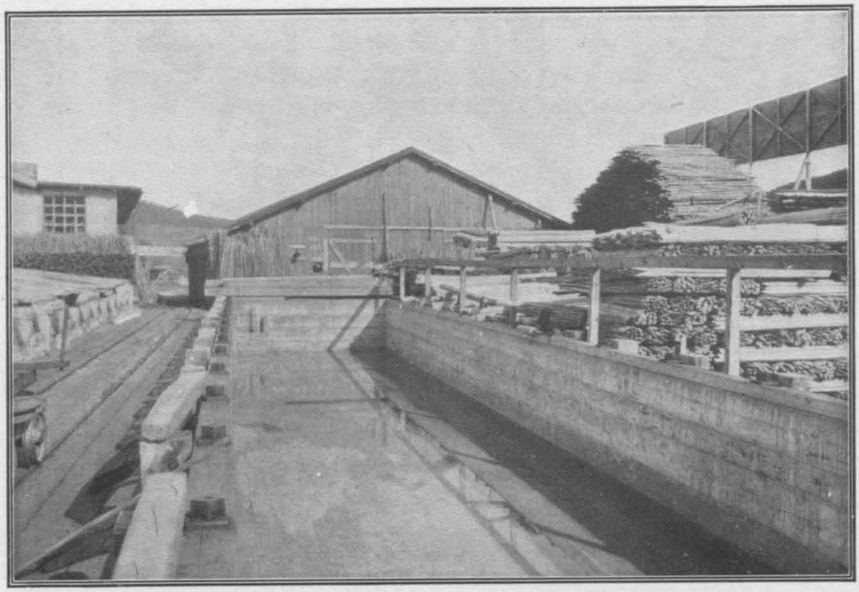

FIG. 1.—VAT FOR TREATING WOOD WITH CORROSIVE SUBLIMATE.

FIG. 2.—TAR OIL VAT FOR TREATING POSTS.

has not been more generally employed by persons using small quantities of timber, who could not put up an expensive cylinder apparatus, such as is required for treatment with tar oil or zinc chlorid.

CAUTION.—Corrosive sublimate, or mercuric chlorid, is extremely poisonous, and care should be taken to prevent unnecessary handling of the solution, especially by persons not familiar with its character. In case of poisoning, the patient should at once drink milk in large quantities, or water in which well-beaten fresh eggs have been stirred—two to three eggs to a quart of water.

TAR-OIL VAT.

In many instances small pieces of timber, such as fence posts, grapevine stakes, etc., can be treated with tar oil very much after the principle of the corrosive sublimate treatment. A small steel tank is used in many parts of Europe for this purpose. This tank is set in masonry in such a way that a fire can be built under it. Tar oil is poured into the tank, the posts or poles are set vertically in it, and a fire is started under it. As soon as the oil becomes thoroughly warm it penetrates into the timber for smaller or greater distances. Pl. LV, fig. 2, shows such a tank used by the grape growers in southwest Germany to treat vineyard stakes. Experiments on a considerable scale are now under way in this country to determine the exact length of time necessary to bring about a certain penetration, particularly with reference to fence posts. It is expected that preliminary results will be available in the course of three or four months. Attention should be called to the fact that treatment of this kind is possible only with absolutely dry wood.

TIMBER-PRESERVING PLANTS.

Where large quantities of timber are used, expensive and complicated preserving plants have to be built. These consist of steel cylinders in which the timber is placed. The preserving solution is then pumped in and forced into the wood either under pressure or by boiling. Preserving plants of this kind are now being operated at a large number of points in the United States. Such plants should preferably be located at some point where large tracts of land can be purchased cheaply, so as to give enough room for piling to permit of the timber being properly seasoned. On that account it is generally poor policy to construct a plant of this character in or near a large city. Locating the plant at or near the center of the district from which the timber is obtained will not only prevent long shipments, but also will considerably reduce the cost of handling. The size of the plant will depend largely upon the amount of timber to be treated.

The statement on the next page is a general estimate of the approximate cost of preserving plants of different tie-treating capacities. This will, of course, vary with the price of land, cost of steel, etc.

Approximate cost of timber-preserving plants of different capacities.

250,000 ties per year	$40,000 to $50,000
500,000 ties per year	50,000 to 60,000
1,000,000 ties per year	90,000 to 125,000

The majority of treating processes, with the exception of those noted below, use a similar form of apparatus, composed of a closed cylinder with a movable door, pumps, tanks, etc. The piping and the pressure limit of the cylinder may differ somewhat in minor details, but the same cylinder can be used both for the zinc chlorid treatment and for the creosote treatment.

COST OF VARIOUS TREATMENTS.

The choice of the kind of treatment to be used will depend (1) on the original cost of the wood; (2) on the cost of treatment; (3) on the increased length of life obtained. Detailed accounts of the methods of treatment will be found elsewhere. At the present time it is of interest, however, to compare briefly the cost of the various treatments. For this purpose the cost of treating railroad ties is taken as a standard, since more attention is now being paid to them than to other classes of material.

CREOSOTING.

Creosoting, as it has been done in the past, is the most efficient and satisfactory method of preserving timber. Well-creosoted wood is known to last indefinitely. Where a high-grade oil is used this treatment will in the long run prove the most satisfactory. At the same time it costs approximately 90 cents to $1 to obtain a creosoted yellow pine tie. The scarcity of creosote, as well as its high price, has prevented its general adoption, but investigations are now under way to secure new sources of supply of this valuable material.

If we compare the actual cost of untreated white oak and creosoted red oak or creosoted loblolly pine, assuming that the untreated tie lasts ten years and the creosoted tie twenty, we may establish the following:

Cost of untreated white oak and of creosoted red oak or loblolly pine ties.

Cost of tie and annual charge.	Untreated white oak (10 years' life).	Creosoted red oak or loblolly pine (20 years' life).
Cost of tie	$0.85	$0.40
Cost of treatment	....	.45
Total cost of tie	.85	.85
Annual charge on a basis of 4 per cent compound interest	.105	.063
Annual charge for renewal at a cost of $0.19 for handling and placing	.016	.006
Total annual charge	.121	.069

The annual charges of untreated white oak, untreated red oak, and treated red oak are as follows:

For a white oak tie lasting 10 years	$0.121
For a red oak tie lasting 5 years	.124
For a red oak tie creosoted, lasting 20 years	.069

These figures show that there is at this time a considerable saving in using creosoted inferior timbers, and this saving will probably increase as the years go on because of the appreciation in price of white oak, longleaf pine, and other high-grade timbers.

Where oil is used, success is possible only with a good grade of tar oil. To secure this, it is important to have some system of inspection which can be applied to every shipment, which shall be as simple as possible, and which shall effectively test the quality of the oil. The following specifications are now being urged for general adoption by the Bureau of Forestry, and indicate what is considered a high-grade oil by the best European standards:

(1) The tar oil must be clear, that is, there must be no substances in suspension. This is best tested by putting a drop of the oil on a piece of filter paper.

(2) The specific gravity must be about 1.04 to 1.10 at a temperature of 20° C. The boiling points must be as follows: Up to 150° C. nothing must come off; up to 200° C. not more than 10 per cent may come off; up to 235° C. not more than 25 per cent may come off; up to 355° C. at least 90 per cent must come off.

(3) The oil must be soluble in benzene or in absolute alcohol.

Attention is called to the fact that specifications 1 and 2 apply only to oils which are completely liquid at 68° F. (20° C.). Certain high-grade oils made in this country contain amounts of naphthalene and anthracene which render them solid at the temperature above mentioned. The specific gravity of such oils should be taken at 2° above their melting point. It has been found that some of these oils also contain a small amount of matter which is not soluble in benzene or absolute alcohol. This is probably due to the presence of small amounts of free carbon. The presence of one-half of 1 per cent of such insoluble matter should not serve as a sufficient cause for the rejection of the oil. In making use of benzene as a solvent the insoluble portion counted should not include water, which in itself will not dissolve in or mix with benzene. On account of local conditions governing the supply and manufacture of creosote oils, the rejection of any oils should not be made on account of slight variations from the specifications.

Creosoting as it is now conducted in the United States consists of several operations. In the first place the timber is steamed, so as to allow the preserving fluid to penetrate into the wood more readily. The creosote is then forced into the wood under pressure. One

operation takes from eight to twenty-four hours. It has repeatedly been urged by the Bureau of Forestry that when timber is thoroughly seasoned there will be no necessity for the steaming operation. In none of the European creosoting plants is steaming resorted to, and their results as regards the length of life are certainly beyond dispute. Recent tests made with creosote, and also with zinc chlorid solution, a substance of far less penetrating power than creosote, have borne out this contention in every respect, and it is urged that wherever possible the steaming operation should be omitted.

At the present time several new processes for forcing creosote into the wood are being tried. Their purpose is largely to permit of a more economical use of this expensive material. While it is yet too early to give a definite statement as to their value, they may be briefly mentioned.

THE RÜPING PROCESS.

The Rüping process consists in forcing air into absolutely seasoned wood at a pressure of about 5 atmospheres. Without relaxing this pressure the creosote is forced in at a higher pressure, and a pressure of 12 to 14 atmospheres is then maintained for several hours. When the wood has absorbed a sufficient quantity of tar oil all pressure is released. The excess tar oil in the wood is then forced out by the compressed air in it. The total quantity of tar oil absorbed by the wood under this method is very much less than with the ordinary system. Extensive tests are now under way to determine exactly how much of a saving can be effected by the use of this process, which promises to be very successful. It seems very probable at this date that the process can be carried out with very much lower pressures.

VACUUM STEAM PROCESS.

A process is now being tried in Europe which has so far shown excellent results in an experimental way. Absolutely dry wood is placed in a cylinder, and tar oil at a temperature of 70° to 80° C. is run into the cylinder. The oil is left in the cylinder from ten to fifteen minutes, during which time a small quantity is absorbed by the wood. The oil is then pumped out and a high vacuum is maintained for about an hour. At the end of this period steam under pressure of 2 atmospheres is introduced into this vacuum for one to one and one-half hours. The object of this steaming is to cause the small amount of oil which is forced into the wood at first to be more evenly distributed throughout the entire piece. The absorption of oil is extremely variable, depending upon the amount of sapwood in the timber. The process is still in the experimental stage. A slight variation of this process consists in the omission of the vacuum. A small quantity of oil is first pressed into the wood, the oil is then run out of the cylinder, and steam is admitted into the cylinder directly after this operation. This also is still in the experimental stage.

ZINC CREOSOTE PROCESSES.

Efforts are still being made in the direction of preventing the leaching out of zinc chlorid by adding tar oil to the zinc chlorid solution. The so-called Rütgers emulsion process is still used in Germany, but there is considerable objection to it because of the unequal distribution of the tar oil in the cylinders, the pieces of wood at the bottom of the cylinder receiving large quantities of oil while those near the top receive very small quantities.

Certain variations are now being tried by the Berliner Holzcomptoir, who add about 5 per cent of wood tar, obtained from the distillation of beech wood, to the ordinary tar oil. This is said to make an emulsion with the zinc chlorid of a more or less permanent character. In this country the injection of zinc chlorid, followed by tar oil (the Allardyce process), is being used to a certain extent with excellent results. The difficulty with all mixtures of zinc and tar oil is that with a single operation a poor tar emulsion is likely to result, while a double operation makes the treatment more expensive.

The cost of treating a tie with zinc creosote, as compared with the cost of an untreated tie, ignoring tie-plates, and estimating the life of the treated tie at sixteen years, may be given as follows:

Cost of untreated ties and of ties treated with zinc creosote.

Cost of tie and annual charge.	Untreated tie (5 years' life).	Treated tie (16 years' life).
Cost of tie	$0.40	$0.40
Cost of treatment		.25
Total cost of tie	.40	.65
Annual charge on a basis of 4 per cent compound interest	.089	.056
Annual charge for renewal at a cost of $0.19 for handling and placing	.035	.009
Total annual charge	.124	.065

THE SUGAR TREATMENT (POWELLIZED WOOD).

During the past summer an English inventor brought forward a process for treating timber with a strong sugar solution. The wood to be treated is boiled in the solution by introducing steam into a tank, which need not necessarily be a closed one. The boiling stops when all the air has been driven out of the wood. After treating the wood in the tank, it is dried gradually for several days, special care being taken to prevent too rapid evaporation. Three points are claimed for the invention: (1) That the process renders timber tougher and stronger; (2) that green timber can in this way be rapidly seasoned; (3) that the timber is to a certain extent rendered decay proof.

It is probable that this process will prove valuable in the treatment of timber for purposes which will not expose it to moisture. Investigations to determine its actual value are now in progress.

ZINC CHLORID TREATMENT.

The cheapest preserving process, and the one most universally employed in this country, is the treatment with zinc chlorid. The great difficulty with this salt is that it leaches out so rapidly from the wood. Numerous improvements in the manner of treating wood with zinc chlorid have been made in the last year. It has been found that by using absolutely seasoned wood it is possible to treat certain kinds of wood by introducing the zinc chlorid solution directly into the tie without the preliminary and customary steaming. In this connection it is important to remember that the principal object sought is to obtain the greatest possible penetration of the preservative. The amount of dry chlorid absorbed can be regulated easily enough by varying the strength of the solution. For the present the customary 2½ per cent solution is recommended.

The following shows the result of some tests made at the Las Vegas treating plant of the Santa Fe Railway, and may serve as an illustration of the subject just referred to:

Record and results of run.

Vacuum begun	5.50 p. m.
21-inch vacuum	6.50 p. m.
$ZnCl_2$ pumped in	6.50 p. m.
80 pounds pressure reached at	7.15 p. m.
Started forcing back	10.15 p. m.
Completed	10.33 p. m.

Ties weighed morning after treatment.

Total weight of ties before treatment (118 ties used)	pounds..	10,602.5
Average weight of ties before treatment	do....	89.9
Total weight of ties after treatment (without steaming)	do....	21,396.5
Average weight per tie after treatment	do....	181.3
Gain per tie	per cent..	101.7

If we compare the cost of inferior timber ties, estimating their life as five years, with that of the same kind treated with zinc chlorid, making the very safe assumption of a ten years' life for them, and again with the same number of ties made from long-lived timber, untreated, estimated as giving ten years' service, we get the following approximate figures:

Cost of treated and untreated ties of inferior timber and of untreated ties of long-lived timber.

Cost of tie and annual charge.	Untreated tie.		Treated tie.
	Inferior timber (5 years' life).	Long-lived timber (10 years' life).	Inferior timber (10 years' life).
Cost of tie	$0.40	$0.85	$0.40
Cost of treatment	....	....	.16
Total cost of tie	.40	.85	.56
Annual charge on a basis of 4 per cent compound interest	.089	.105	.069
Annual charge for renewal at a cost of $0.19 for handling and placing	.035	.016	.016
Total annual charge	.124	.121	.085
Annual charge for 500,000 ties	62,000	60,500	42,500

The principal points considered may be briefly summed up as follows:

(1) It is more profitable to treat inferior, cheap timbers, such as loblolly pine and red oak, than longleaf pine and white oak, as the latter timbers take treatment very poorly.

(2) It will pay better in the long run to treat these inferior timbers with a preservative, for the annual charge is thereby brought down to a lower point than when untreated timbers are used.

(3) All timbers should be thoroughly seasoned before being treated. Seasoned timber not only takes treatment better and consequently has longer life, but it is also easier to handle.

(4) For the present, the following preservatives are recommended:

For fence posts.—Fence posts, if they are to be preserved, can be either charred or treated when absolutely dry with such substances as carbolineum, spirittine, or tar oil. They can also be soaked in corrosive sublimate. Telegraph and telephone poles can likewise be treated by applying hot tar oil, carbolineum, or spirittine.

For structural timber.—When structural timber is to be used in large quantities, and where the odor is not objectionable, this class of material should be treated with creosote, using about 10 pounds of tar oil per cubic foot. Where only a slight protection is necessary, tar-oil products can be applied from the outside provided the wood is absolutely dry.

For ties.—The treatments recommended for ties at present are three:

Creosoting.—The creosote should be of a high grade, as per specifications already given. About 10 pounds of oil should be used per cubic foot.

Zinc chlorid.—Zinc-chlorid treatment is the cheapest recommended at the present time, and the only modification suggested as to its use is the omission of the steaming stage whenever, after sufficient trial, it is found that this can safely be done.

Zinc chlorid and tar oil.—The treatment of porous timber with zinc chlorid, followed by a treatment of 3 pounds of tar oil, is recommended as a process which will give good results.

It is probable that within the next six months one or another of the new processes will have been tested sufficiently to warrant its being recommended.

For piling.—The only treatment recommended for piling is the tar-oil treatment. This is true whether the pile is to be used in structural work on land or for marine work. The only difference between the two is that piling used in marine work ought to have very much more tar oil. The following quantities of tar oil per cubic foot of timber

are recommended: For use in fresh water, 16 to 18 pounds of tar oil; for salt water, in the latitude of New York, 12 to 14 pounds; between New York and Florida, about 20 pounds; and for Gulf points, 22 to 25 pounds. For Pacific coast points larger quantities of oil are required in northern latitudes than for Atlantic coast points; so at Seattle at least 20 to 22 pounds of oil per cubic foot should be used. The tar oil used for marine wash should have a high percentage of naphthalene.

In general, the porous woods should have preference. It will pay better in the long run to use treated loblolly pine for piling than longleaf pine. The unsatisfactory results obtained by many with creosoted piling can almost always be traced to poor treatment with poor material.

SOME SOIL PROBLEMS FOR PRACTICAL FARMERS.

By E. C. Chilcott,

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INTRODUCTION.

That the practical farmer, the tiller of the soil, should thoroughly understand the soil that he tills is a proposition so self-evident that at first thought it would seem useless to discuss it, and yet careful observation will surely make us realize how slow practical farmers have been to avail themselves of the knowledge within their reach concerning the soil, its origin, and its properties. The responsibility for this condition of affairs does not rest entirely with the farmers themselves. It is largely the result of faulty methods of education in our common schools, high schools, and colleges.

STUDY OF GEOLOGY AND SOIL CONDITIONS.

In many of the common schools the study of physical geography is either entirely neglected or taught by instructors who know little more of the subject than is contained in the very elementary text-books used, who have no knowledge of geology, and no conception of the very intimate connection between physical geography and the agricultural resources of a country. Many of these teachers have never had an opportunity to learn at first hand from nature the things they are expected to teach. They are not to be blamed for this condition; it is one of the very unsatisfactory results of our system of education, which places the instruction of the young, especially in the rural schools, in the hands of inexperienced teachers. Such teachers can not be expected to impart a broad and comprehensive knowledge that will be of value to the practical farmer in after life, for they do not possess it themselves.

Much has been written lately in favor of teaching agriculture in the public schools; but, until teachers can be found who can teach physical geography and geology from an agricultural standpoint, there is little prospect of finding competent teachers of agriculture.

TEACHING GEOLOGY IN HIGH SCHOOLS AND AGRICULTURAL COLLEGES.

The teaching of geology in high schools and colleges is not much more satisfactory. Even in many of the agricultural colleges very little attention is given to geology, and what little instruction is given

is by teachers who have no knowledge of agriculture, and who, consequently, do not attempt to teach the student the close connection between geology and agriculture.

Geology is so broad a subject that teachers of this science are almost forced to select some quite restricted branch of the subject along which they will specialize, to the partial or entire neglect of other branches. Unfortunately, we have very few geologists who have specialized along the line of agricultural geology. The agricultural colleges should, and it is to be hoped that in time they will, turn out young men well equipped to teach geology from an agricultural standpoint.

THE STUDY OF PHYSICAL GEOGRAPHY BY THE FARMER.

In the meantime, what is the practical farmer to do, who realizes that he does not possess the knowledge of physical geography and geology necessary for intelligent comprehension of the practical problems in connection with the tillage of the soil, in order to supply the defects in his early education?

First, let the farmer procure a copy of any one of the numerous standard modern elementary text-books of physical geography. No farmer of average intelligence and a fair knowledge of the English language, who will bring to the task a mature mind, more or less practical experience and observation, and an earnest desire to learn, will find any difficulty in mastering the subject, as set forth in such a text-book, in a very short time. He will not find it necessary to learn so very much that is entirely new to him, but he will be brought to see the relations and bearing of many facts that he was already familiar with. He will frequently be surprised to discover what a fund of valuable information he had gathered from experience and observation, but had not been able to use because his attention had never been called to the bearing and relation of these facts.

If there are young members of the family who are studying or have studied physical geography in school, they can materially assist their elders in the study; and, furthermore, it will be a great stimulus to these young people if they find the subject has a practical side of such importance that their parents are interested in it. The practical knowledge and experience of the mature man will supplement the theoretical knowledge of the student, and they will be mutually helpful to one another.

THE STUDY OF GEOLOGY BY THE FARMER.

Having become familiar with the subject of physical geography, the next step should be to take up the study of some elementary work on geology. In selecting a text-book the name of the author is not of so much importance as that the work itself be up to date. The science of geology is advancing so rapidly that all the publishers of standard text-books find it necessary to make frequent revisions, and only the

latest editions should be used. It is a quite generally accepted opinion among those who have never studied geology that it is so profound, not to say mysterious, a science that only those with college training can comprehend it. Such an opinion is entirely erroneous; for while it is true that the geologist who would undertake original investigation, either in the field or in the laboratory, must be well grounded in the sciences of mineralogy, chemistry, physics, biology, astronomy, and mathematics if he expects to take a place among the leaders of the profession, it is also true that these investigators are able to expound many of the complex problems in geology in language easily comprehended by any person of ordinary education; and this has been done in the elementary text-books in use in the schools.

In no other vocation, with the possible exception of mining, is a knowledge of the fundamental principles of geology more necessary than in farming. It might even be questioned whether the miner is able to utilize the teaching of geology as fully as can the farmer; for while the miner must possess some knowledge of structural geology, gained either from books or from experience and observation, the farmer finds a knowledge of all the subdivisions of geology equally serviceable to him. A knowledge of dynamic, structural, and physiographical geology gives him an insight into the origin and characteristics of the soil, the tillage of which constitutes so large a part of his vocation, while a knowledge of historical geology shows him how all the plants and animals with which he has to deal have slowly developed from lower and simpler forms. In fact, the work of the farmer and stock breeder in improving cultivated plants and domesticated animals is simply a continuation of the process of improvement carried on by nature before man existed, and for a long period after his advent, and before he had developed in the scale of intelligence to the point where he began to recognize the benefit to himself that would result from his taking advantage of the forces of nature to shape animals and plants to his rapidly increasing needs and wants.

There are very few practical farmers who will not find it profitable to devote some time to the study of physical geography and geology after their minds have matured and they have acquired a store of practical experience.

The extent to which the study should be carried must necessarily be determined by the tastes and intellectual bent of the individual concerned, but it should certainly be sufficient to enable him to read intelligently the various reports issued by the United States and his own State geological surveys. He should make himself thoroughly familiar with these reports, at least so far as they deal with the conditions in his own State, or with broader and more general problems with which he will have to deal as a practical farmer and business man. In this day of world-wide competition it is not sufficient that

the farmer shall be acquainted with his local conditions only. He must possess a general knowledge of the conditions surrounding those with whom he is to compete in supplying the world with its food products. Commercial geography is a subject with which all producers as well as all dealers should be familiar.

No doubt many farmers who read the above will say that this is simply theorizing, and that it is not practicable for a farmer to undertake such a course of study. It is hoped that the writer may be excused for stating that he is and has been for twenty years a practical farmer, and that the above opinions are the outgrowth of his personal experience as such.

ESSENTIALS FOR THE PROGRESSIVE FARMER.

With the knowledge above suggested the farmer is in a position to keep abreast of new developments along agricultural lines by keeping in close touch with the agricultural college and experiment station of his own State and with the United States Department of Agriculture. He will also be in a position to take up lines of investigation and experimentation for himself upon his own farm that will not only add to his prosperity, but will give him an added interest in his farm life.

HOME STUDY OF SOIL PHYSICS.

In nearly all of the more progressive agricultural colleges of the country, laboratories are equipped with quite extensive and elaborate apparatus for the study of soil physics, as is fully described and illustrated in a recent publication of the United States Department of Agriculture.[a] All farmers who can take a course in soil physics in one of these institutions should do so; but there are thousands of intelligent, progressive farmers who can not spend the necessary time away from their farms. These farmers, however, need not feel discouraged. There are a great many very important problems in soil physics that must be solved on the farm if they are ever to be solved, and, indeed, the value of laboratory training and study depends entirely upon the character, experience, and practical knowledge of the soil, and its behavior under actual field conditions, possessed by the teacher. The ultimate object of all study of soil physics by those who are fitting themselves for practical farmers is to become so thoroughly acquainted with the various types of soil with which they are likely to have to deal in actual farm operations that they will be able to recognize them as soon as they see and handle them, and to know the crop-producing powers of each under the conditions where they are found; to be able to decide what methods of tillage will place each in the best possible condition for the crop to be grown upon it under varying climatic

[a] Bulletin No. 127 of the Office of Experiment Stations.

conditions, and how best to supply any lack of plant food that may exist.

There is no doubt that most of this knowledge must be acquired in the field, under actual farm conditions. Laboratory methods of instruction that will assist in acquiring this knowledge without obscuring the objects sought are to be commended. But the time and energy of the student must not be so taken up with mastering the details of the methods adopted for establishing certain facts as to lose sight of the object for which these facts are sought. The teacher must constantly keep before the mind of the student the practical application of the principles demonstrated in the laboratory.

STUDY OF MECHANICAL CHARACTERISTICS OF SOILS.

Every practical farmer should know something of the mechanical characteristics of different types of soil, and particularly of those with which he has to deal on his own farm. If he can have made for him, by some competent person, mechanical analyses of the various types of soils with which he has become acquainted through practical experience and observation, he will be able to see the causes of some of the productive peculiarities of these soils that he has already observed but can not explain, and in many other ways the knowledge gained from these analyses will be of value. For a practical farmer to undertake to become an expert soil analyst is, however, a waste of time. The same may be said of nitrogen and specific gravity determinations and many other laboratory processes required of students in some of the agricultural colleges. "Art for art's sake" is nowhere more out of place than in laboratory instruction in soil physics for the practical farmer.

REQUISITES FOR THE SUCCESSFUL TEACHER OR INVESTIGATOR.

The above remarks do not, of course, apply to those who are fitting themselves for teachers or investigators in the theory of soil physics, for to them laboratory work is of the highest importance, and such work offers a very inviting field of usefulness for those who are fitted for it. It is most important, however, that every teacher or investigator in agriculture should be thoroughly familiar with the soil and with all farm operations. He should know how the different soils behave under different methods of tillage in the field, under all the varying climatic conditions that are to be met with in the country where he is located; and in addition to this he should have a broad general knowledge of conditions, methods, and results in other parts of the world. He should have a good working knowledge of geology, physics, and chemistry, in so far as they apply to the soil and plant production, and he should not only be familiar with the results obtained

by specialists in laboratory investigations in soil physics, but also with the methods used in their investigations. Without these qualifications he can not be a successful teacher.

The farmer should have the same general knowledge of the soil, agricultural methods, and climatic and economic conditions as is needed by the teacher or investigator. He should also be acquainted with the results obtained by these investigators, though he need not be able to perform the laboratory manipulations. There are thousands of successful business men who never attended a business college and who know nothing of the methods of instruction employed in them. Although many of our best farmers attained their success without direct assistance from the agricultural colleges and experiment stations, all of them have profited very largely from the indirect benefits they have received from these institutions, which have, by investigation and teaching, added so enormously to the general store of knowledge. This knowledge has become public property, and has benefited thousands of men who have never come in direct contact with any of these institutions.

RELATION OF THE SCIENTIST TO THE FARMER.

Farmers as a class are conservative, and they have not been as quick to grasp indirect benefits as those engaged in other vocations. The reason for this is largely their failure to realize how, by a little effort on their part, they can fit themselves to make available the vast stores of more or less theoretical knowledge accumulated by the scientists.

On the other hand, there has been, and still is, a tendency on the part of some scientists to belittle the value of the knowledge and experience of those unacquainted with the mere machinery that they have used in obtaining their knowledge. A better understanding is, however, being brought about between the practical farmer and the experiment-station worker. The very best men in the agricultural colleges and experiment stations frankly admit that many practical farmers who know little or nothing of the methods adopted by scientists, nevertheless, have, by observation and practical experience, gained such a knowledge of the soil and its requirements for crop production that they can, from a simple examination of the soils with which they have become acquainted, make a reliable estimate of their crop-producing capacity.

What is needed is that the scientist should be thoroughly acquainted with the soil and plant growth under actual field conditions, and should know the actual results of the various methods of tillage and farm management, although he does not perform any of the actual operations of the farm himself, and that, on the other hand, the farmer should keep himself posted as to the actual results of the investigations carried on by the scientist.

All information given to the farmer by the scientist, either in the class room or through publications or public lectures, should deal with results and not with details of the methods by which those results were obtained. Only such information should be given concerning the details of the methods used to obtain the results as will enable the farmer to judge intelligently of the value of those results. And in giving these details the scientist should be absolutely frank in admitting the defects and limitations of his methods. Field conditions can not be duplicated in the laboratory, and laboratory results will not hold good under field conditions, although certain general principles may be demonstrated by laboratory methods.

CROP ROTATION, METHODS AND VALUE.

Among the many problems that may and should be worked out both at the agricultural experiment stations and upon private farms, few can be found that are of greater importance and of more universal application than that of crop rotation.

Some very significant facts are brought out in the article upon "Practices in crop rotation," contributed to the Yearbook for 1902 by George K. Holmes, of the Division of Statistics, Department of Agriculture. He says:

> Haphazard is a mild word to describe the impression given by the reports of the correspondents with regard to the rotation of crops in many counties and parts of counties of the United States. Although there may be an annual change of crop on the same land, this change is so uncertain, so unsystematic, that at first it seems impossible to establish order out of the chaotic mass of particulars.

In another place Mr. Holmes says:

> A diminution in the degree of rotation hardly appears until Ohio is passed, and then the diminution is gradual until in the longitude of middle Kansas rotation is of the simplest, when existing at all.

In the same article, speaking of the use of fertilizers, is the following:

> There are still extensive regions in the United States where barn manure is considered a farm nuisance. In a county in Oregon the neighbor is welcome to haul away this manure, and that neighbor is likely to be a thrifty German with a large garden; in other Oregon counties the manure is burned. In a California county the manure is dumped into ravines; it goes to the creek in Oklahoma; it is hauled to a hole in the ground or put on one side of the field in Kansas; South Dakota farmers burn it to be rid of it, and sometimes burn it for fuel. In North Dakota farmers haul barn manure to piles and leave it there until it disappears; farmers in Missouri deposit it by the roadside, and in Idaho scrapers are used, and it is "often seen piled as high as a barn."
>
> In many counties between the Mississippi River and the Pacific Ocean farmers not only find barn manure a nuisance, but they have a grievance against it, claiming in South Dakota that it produces dog fennel, elsewhere that it produces other weeds, and in various counties that it has such an effect of "poisoning" the soil that farmers are afraid of it.

The foregoing statements are all true, but they ought not to be. One can not help exclaiming in the words of Polonius, "'Tis true 'tis pity; and pity 'tis 'tis true." Not only are these statements true when applied to the localities mentioned, but they would be equally true of many other localities.

The farmers are not alone to blame for this condition. In the article quoted the statement is made that "The farmer is in a rut, lacks initiative, and needs help to get out." This is true, and to a certain extent always will be. Are the agricultural colleges and experiment stations doing all they might do and ought to do to help the farmer out of this rut? In some States, yes; in others, no. It would not be difficult to name some agricultural colleges where thousands of dollars are being expended annually in teaching young farmers how chemical and physical analyses are made where absolutely nothing is being done in a practical, systematic, scientific way to test the value of crop rotation and the application of manures under ordinary field conditions. Is there not, then, some ground for the "contempt of book farming" mentioned by Mr. Holmes as being felt by some practical farmers, and are not the colleges and stations in part to blame for the condition mentioned?

WORK IN CROP ROTATION AT EXPERIMENT STATIONS.

There may be experiment station farms in the United States where it is impracticable or needless to carry on work in crop rotation, but it would be difficult to imagine where they are located. Most, if not all, should be carrying on experiments, not with one but with many systems of crop rotation. This work should be carefully planned and systematically and uninterruptedly carried on for a long succession of years. In fact there is no limit to the length of time to which it should be extended. It will become more and more valuable as time goes on. It should embrace not only those rotations which the experience of practical farmers has indicated as best adapted to the local conditions in the State; but it should also include others, both good and bad; those that seem to be bad may prove to be good, and those that prove to be bad may be as valuable, as object lessons, as those that give better results.

In connection with this work of crop rotation many other lines of work could be carried on, such as studies in the movement and conservation of soil moisture, application of fertilizers, methods of tillage, nitrification, leaching of soils, effect of green manuring, and the growth of leguminous plants, etc. But these should be considered as accessory to the main problem of crop rotation. Crop production through a long term of years should be the crucial test of the value of any rotation, and these results should never be obscured by the introduction of any side line.

As a rule, it will not be advisable for the practical farmer to carry on more than one, or at the most two, rotations on any one farm. A

system of crop rotation should be planned to last for generations, and should not be undertaken without careful consideration. The farmer should become thoroughly acquainted with the subject before he adopts any system. This he ought to be able to do by applying to his own State experiment station. The men in charge of the work there ought to be able to furnish him with more, and more valuable, information than he can obtain from any other source. Here, then, is a field for the practical application of the science of soil physics where close cooperation between the practical farmer and the scientist can be mutually beneficial.

COMPARISON OF HUMID AND SEMIARID REGIONS.

Mr. Holmes, previously quoted, makes the following statement in the article mentioned: "In semiarid regions barn manure needs to be used cautiously on unirrigated land." He also mentions "the limitations of the semiarid regions," and finally says: "Unirrigated lands in the arid and semiarid regions labor under such limitations that they can not be compared with other parts of the country in such a matter as crop rotation." These statements, like the others quoted, are in the main true, but the limitations of the semiarid regions are not as restricted as might be inferred from the words quoted. Neither does it seem true to the writer that crop rotation in semiarid regions is so different from crop rotation in humid regions that the two can not be compared. On the other hand, it would seem that a comparison of the problems involved in crop rotation in the humid and in the semiarid regions would be of value in bringing out certain fundamental principles involved in both. The limitations are mainly in the kind and number of crops that can profitably be produced in the two regions, and the difference in this respect is not so great as might at first be supposed, as will be seen from an examination of the rotations given below.

The main difference in the nature of the problems involved, between the humid and the semiarid regions, is that in the humid regions the most important object sought is the conservation of the soil fertility or plant food, while in the arid and semiarid regions it is the conservation of soil moisture. Of course, neither of the factors can be disregarded in either region, but the relative importance of each is as stated. In other words, the farmer in the humid region is mainly interested in the chemical problems involved, while in arid and semiarid regions the most important problems are those of soil physics.

USE OF BARNYARD MANURE.

What has been quoted from Mr. Holmes concerning the need of caution in using barn manure is true, and it is true because the physical effects produced by an application of the manure are often of

greater importance than the chemical ones. It is quite frequently the case that the bad physical effects of the application more than offset the beneficial chemical ones. But when this fact is recognized and due consideration is given to these physical effects, manure can be applied in semiarid regions with beneficial results without danger to the physical condition of the soil. In summing up the results of some experiments in the application of manure to wheat, conducted by the writer in 1897 and 1898, and published in Bulletin No. 79 of the South Dakota experiment station, the following statements are made:

> The farmer should fully understand that while the application of barnyard manure to the soil is certain to have a beneficial effect by adding to the store of plant food, its effect may not be apparent in the results of the first crop after the application, and that the immediate mechanical or physical effects upon the soil may be either beneficial or detrimental, depending upon the character of the soil, the kind of manure, the time and method of application, the nature of the crop, and the character of the season as to moisture and temperature.
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> The soil of the farm should be considered a bank in which the surplus resources of the farm, in the form of plant food, should be deposited with the understanding that the surplus can not be withdrawn at once, but is to remain until such time as the conditions are favorable for its utilization. With our light rainfall and retentive soil the danger of loss from leaching is very slight.
>
> From our experience and observation we believe we are warranted in recommending as the surest method of guarding against the possible bad physical effects of the application of the manure that it be applied to land intended for corn instead of wheat; that it be hauled direct from the stable during the late fall, winter, and spring, and plowed under in the spring. The corn will be likely to be benefited, and the wheat crop that should follow the corn will probably be improved as much or more than it would be if the manure were applied directly to that crop.

CROP ROTATION AT SOUTH DAKOTA EXPERIMENT STATION.

The writer has been engaged in experiments in crop rotation at the South Dakota experiment station for the last seven years. Below is given a list of the various rotations which have been carried on continuously and systematically for that period and are still under way:

1. Flax, barley, millet, wheat, corn.
2. Wheat, oats, peas (fed),[a] wheat, roots.
3. Oats, wheat, fallow, wheat, corn.
4. Wheat, barley, peas (plowed),[a] wheat, corn.
5. Wheat, oats, corn, flax, millet (fed).
6. Wheat, barley, peas (cut),[a] wheat, corn (fed).
7. Wheat, corn, wheat, oats.
8. Wheat, corn, oats, millet.
9. Wheat, corn (manured), wheat, oats.
10. Wheat, corn, oats.

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[a] Where the words "cut," "fed," and "plowed" are used in parentheses after a crop they indicate whether the crop was allowed to mature, and was *cut* or harvested in the usual manner, was *fed* off by stock before it reached maturity, or was *plowed* under for green manure. The word "manured" following a crop indicates that barn manure was applied at time of planting.

11. Oats, fallow, wheat.
12. Barley, millet, wheat.
13. Barley, peas (cut), wheat.
14. Wheat, wheat, fallow.
15. Wheat, wheat, corn.
16. Wheat, fallow.
17. Wheat, corn.
18. Wheat, vetch.
19. Wheat continuously, no manure.
20. Wheat continuously, manured every five years.
21. Wheat continuously, manured every three years.
22. Wheat continuously, manured every year.
23. Wheat seeded to brome grass, brome, brome, flax, wheat, corn.
24. Wheat seeded to brome grass, brome, brome, wheat, corn.

Space will not permit more than the briefest mention of the results of these experiments; but in order to bring out the beneficial effects of a proper rotation under arid conditions the following table and explanation are given. The season of 1900 was one of the most unfavorable experienced here for many years. Crops on many neighboring farms were a complete failure on account of the lack of sufficient moisture at the proper time, while the season of 1901 was a fairly favorable one. The yields given are the averages for plats in the aforementioned rotation, grouped together according to the kind of crops which immediately preceded the wheat and oat crops, respectively.

Yields of wheat and oats in different rotations compared for an unfavorable and a favorable season.

Rotation.	Number of plats.	1900 Straw.	1900 Grain.	1900 Ratio, 1 to—	1901 Straw.	1901 Grain.	1901 Ratio, 1 to—
Wheat after—		*Pounds.*	*Bushels.*		*Pounds.*	*Bushels.*	
Fallow	4	2,375	15.00	2.64	2,848	15.66	3.03
Corn	6	2,280	13.91	2.73	2,958	17.35	2.84
Oats	4	1,150	3.96	4.84	2,558	16.75	2.54
Peas (fed)	1	1,920	7.16	4.46	2,660	18.16	2.44
Peas (cut)	2	1,645	4.66	5.87	3,020	14.66	3.43
Peas (plowed under)	1	2,290	14.83	2.57	2,980	17.00	2.92
Potatoes	1	2,300	13.33	2.88	2,870	17.16	2.79
Vetch	1	1,620	7.16	3.77	2,580	15.33	2.80
Millet (cut)	3	1,773	6.55	4.51	2,770	16.53	2.83
Millet (fed)	1	1,770	10.50	2.81	3,020	16.33	3.08
Wheat	6	1,415	3.60	6.63	2,805	15.46	3.02
Average	....	1,867	9.15	....	2,824	16.38	....
Oats after—							
Wheat	5	2,046	12.63	5.06	2,358	48.14	1.53
Corn	3	2,280	28.75	2.48	2,313	47.59	1.54
Average	....	2,163	20.69	....	2,350	47.87	....

This table shows that the average yield of wheat from 30 plats was but 9.15 bushels per acre for 1900, while that from the same number of plats in the same rotations was 16.38 bushels for 1901.

The average yield of oats from 8 plats was 20.69 bushels per acre for 1900 and 47.87 bushels for 1901. These figures fully bear out the conclusions arrived at from previous considerations, that 1900 was a very unfavorable and 1901 a fairly favorable season; but in spite of the very unfavorable conditions which prevailed in 1900 there were 12 plats out of the 30 that yielded on an average 14.27 bushels of wheat per acre. Four of these had been summer fallowed in 1899, 6 had raised a crop of corn, 1 a crop of potatoes, and 1 a crop of peas which had been plowed under. The other 18 plats yielded an average of only 6.23 bushels. Of these, 4 had raised oats in 1899, 3 peas, 1 vetch, 4 millet, and 6 wheat.

Of the 8 plats of oats raised in 1900, the 5 that followed wheat yielded only 12.63 bushels per acre, while the 3 that followed corn produced 28.75 bushels per acre.

It will be seen that in the case of the wheat an increased yield of 8.04 bushels was obtained where the wheat followed summer fallow, corn, potatoes, or peas plowed under, while the advantage of raising oats after corn instead of after wheat was 16.12 bushels of oats. As a bushel of wheat is usually worth from three to four times as much as a bushel of oats, it would have paid better to have raised wheat after corn and oats after wheat in all the rotations.

The yields of both wheat and oats for 1901 were quite uniform and fairly good, although they were undoubtedly 2 or 3 bushels less than they should have been, judging from the growth of straw. This reduced yield was caused by the very hot weather in July. It will be noticed that the heaviest yields of grain were from plats having the lightest growth of straw, and the lightest yields of grain were from plats having the heaviest straw, showing, as has frequently been observed, that where there is a very rank growth of straw the damage from hot winds is usually greater than where the growth has not been so luxuriant. There seems to have been no advantage from sowing wheat on summer fallow or corn land. In fact, the summer fallow plats fell below the average by 0.72 bushel per acre.

While we should guard against forming too positive opinions upon an experience limited to six years, the evidence so far obtained certainly points very strongly toward the conclusion that, during years when there is a sufficient supply of moisture and a suitable temperature properly distributed throughout the growing season, good yields of wheat may be obtained from our average prairie soils, where the crop is properly put in, without much regard to the kind of crop the land has raised the preceding season. But when the supply of moisture is deficient for the season, or is not properly distributed, a fair average crop can be produced where a suitable rotation is practiced, while partial or total failure will result where wheat is sown after a crop that does not leave the soil in the proper physical condition. In short, it would seem that our soils, after twenty years' continuous cropping, have a sufficient supply of plant food to produce good crops, provided the physical condition of the soil is such that there is enough water to make this supply of food available to the plant.

CONCLUSION.

From the results of the above experiments and from a residence of twenty years in the semiarid regions, the writer feels warranted in stating the opinion that in no part of the United States is the subject of crop rotations of greater importance than in the arid and semiarid regions.

Crop rotation is only one of the many soil problems that should be worked out in the field at the experiment stations and by farmers upon their own farms; and the farmer and the scientist should keep in close touch, so that each may profit by the experience of the other.

PROGRESS OF ROAD BUILDING IN THE MIDDLE WEST.

By R. W. Richardson,
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INTRODUCTION.

Prior to the era of railroad building, which had its beginning in the decade following the close of the civil war, public road construction made the most progress in the States of the Middle West. This was under the toll-road system, and several of the States bordering the Mississippi River still retain the old toll-road enactments upon their statute books. These roads linked together the principal towns and connected the shipping and commercial centers with the interior. They daily presented busy scenes of travel and traffic, being the sole avenues of transit, as there was not a single mile of railroad west of the great river in 1850 and but a limited mileage up to 1870. While the toll-road system, with few exceptions, has been abandoned, these roads still remain and are maintained and kept free for public travel out of the general road funds of the counties through which they pass. There has been some further progress in road building in the counties containing important cities, and there are many substantial and beautiful stone and gravel roads leading to and from these centers. Some benefit has also been derived from grading, crowning, rolling, dragging, and draining the common earth roads; but, with these exceptions, no general progress in permanent improvement has been made in the last half century.

It is frequently asserted that, since the era of railway development, the railroad has assumed, to a greater and greater degree, the functions of the common road, and that the construction and extension of improved highways are no longer necessary, nor are they an indication of progress. This is true only to a limited extent. Railroads can never supersede the common roads; almost every ton of freight carried by them must be carried over highways at one or both terminals, and the cost of this highway transportation has a marked influence, not alone on the price paid by the consumer, but also on the profit realized by the producer. The highways are not only important as a means of local intercourse, but they act as feeders to the railway lines, thus becoming absolutely necessary to the perfection of modern transportation systems. The managers of the great railway systems of the country appreciate this, and are without exception actively favorable to any movement for better highways.

FORCES AT WORK FOR HIGHWAY IMPROVEMENT.

The extension of the free delivery of rural mails and the rapid development of motor vehicles are potent influences in advancing the era of highway improvement in these States. It is hardly necessary to dwell upon the effect of rural mail-delivery extension in creating the necessity for better roads. This division of the postal service has made it a prerequisite to the establishing of a rural delivery route that the road must be placed and maintained in good condition for efficient service. But there is a lack of proper inspection. Some carriers endure the worst road conditions without complaint to the authorities, while the postmasters, whose duty it is to report these road conditions, are, in many instances, indifferent and careless. However, the rapid extension of this system is having, and must continue to have, a commanding influence for improvement of the highways.

The great motor-vehicle interests are now beginning to direct their attention to the necessity of improved roads. It can hardly be explained why these people, alert in business and devoting their energies to the perfection of the motor vehicle, should have so long taxed their ingenuity to construct a machine which will resist the strain of grades, rocks, ruts, mud, and all kinds of miserable road conditions, and devoted so little of their time and effort to improving the conditions primarily essential to the success of this mode of transportation.

Other forces are hastening the period of highway betterment. The continued bad roads of the past two years, caused by the wet seasons in the Mississippi Valley States, have very materially affected the commercial interests of this section. The idea that "good roads" could be constructed and maintained by merely grading and draining the surface of the ground has been dispelled, and it is now evident that it will be necessary to surface these roads with some durable material which will render them permanent and efficient for traffic during all parts of the year, and especially those seasons when the roads are most needed for the movement of products. During the winter and spring of this year (1903) wagon transportation in many of these rich valley States was almost wholly suspended for weeks at a time. Long accustomed to these conditions, the people endure them with a patience and resignation they would not show under any other circumstances. What a cry would go up if the railway traffic of the country were suspended for any such period by reason of a failure to provide properly constructed railways to meet the conditions of all seasons of the year!

Business men are learning by experience that improved highways are primarily essential to uninterrupted trade and to their commercial prosperity. Their organizations are giving active consideration to the problem of building durable public roads leading to and from the trading centers of their respective communities. Retail merchants are seriously affected by bad roads, which frequently entail loss of business,

or at least prevent a profitable season's trade. When a country merchant is thus affected the effect in turn extends to the wholesale dealer. Collections become poor, remittances are delayed, extensions of credit are asked for, stock is left on hand to become shelf worn, and a generally unhealthy and profit-losing situation prevails. Commercial and industrial interests are, therefore, awakening to the necessity of their cooperation in hastening the era of road building.

THE RURAL POPULATION AND THE ROADS.

It has long been considered in this country that the public roads are for the exclusive use and benefit of the people living in the rural districts, and that this class alone should be held responsible for their construction, care, and maintenance. This is an erroneous idea. It is true that in the Middle West a large majority of the population resides in the country, either in the small towns or on the farms. In Iowa, with a population of more than 2,200,000, there are residing in the country districts 1,650,000. In Missouri, with a population of more than 3,100,000, there are living in the country nearly or quite 2,000,000; and conditions are much the same in the other Middle West States. In this section the rural population has, during the ten years ending with 1900, increased faster in comparison with the urban population than during previous decades. This has resulted from the building of trolley and steam-railroad lines. If such a result is produced by the extension of electric lines and steam railways, how much more may be expected when the common roads of the country are brought up to the same degree of perfection! It will speedily remove apprehension of the serious evils growing out of the overcrowded and congested condition of our cities; it will dispel the isolation of country life, and it will assure happy homes with pure air and elbow room for a larger element of our population. A large majority of the people will be directly benefited by the improvement of the roads. It may be asserted that, as the greater number of the people live in the country and as the agricultural interests are more directly benefited by good highways, it is but just that they should bear the burden of their cost and maintenance. It must not be overlooked, however, that the cities are the centers of commerce and wealth, the focus points of all public roads, and that they are sustained principally by this rural population. They should, therefore, bear their part in maintaining adequate means of intercommunication. As the whole people are benefited by improved roads, all should share the burden of their cost and maintenance. The plan of depending upon the rural districts alone to provide durable highways has signally failed.

REASONS FOR LACK OF PROGRESS IN ROAD BUILDING.

That we have heretofore made no substantial progress in road building may be attributed to several causes.

First. The excellence and rapid development of our railway systems, and our extensive waterways.

Second. Our long familiarity with bad roads and the indifference of those in charge of highway affairs.

Third. The lack of appreciation of the social, commercial, and economic value of good roads, and the fear of increased taxation on the part of the rural population.

Fourth. The wasteful and ineffective system of requiring personal service of the rural population on the highways.

Fifth. The lack of general authority, intelligent supervision, provisions for equitably distributing burden of cost, and business methods in highway construction and maintenance.

STATE AND NATIONAL AID.

The experience of Europe in road improvement shows that the highways should be taken as much as possible out of the hands of local authorities and be administered by the State governments. Washington recommended in a letter to Patrick Henry that the roads of Virginia be taken away from the control of the county courts and be placed under the State authorities. Alexander Hamilton was an enthusiast on the subject of road improvement, and recognized thoroughly that roads left to local authority would never be satisfactorily built or extended.

The States of Massachusetts, New York, New Jersey, and Connecticut have made the greatest progress in the permanent improvement of their highways. The administration of the road affairs of these States is in the hands of competent State commissions of engineers. The roads are constructed under what is known as the State-aid plan, the cost being apportioned to the State, the county, and the local district, thus insuring proper system, supervision, construction, and maintenance, and giving the people, in return for money expended, good public roads, which they welcome with growing appreciation. There seems to be an increasing sentiment in Middle Western States in favor of State and National aid in permanent road building. Replies to direct inquiries in a majority of the counties in Iowa and Missouri have in nine cases out of ten been favorable to this plan. Practical experience in the older States has demonstrated that State administration and aid in highway construction is a great step toward the solution of the road problem. The Government's work for good roads at present is merely educational and experimental. It is now claimed by some that, if the Government can aid railways and waterways, and construct carriage drives through the National parks and reserves, and wagon roads for Porto Rico and the Philippines, there is no satisfactory reason why it may not lend aid to the improvement of the highways in the States, especially the principal postal roads, thereby advancing the commercial, agricultural, industrial, social, and educational interests of the people.

It is impossible in any State to provide a fit system of highways by the action of boards which have only local authority, and which are necessarily swayed by local, if not individual, interests. No good system of roads has ever been developed except under authority lodged in the hands of some central administration. Under any other system we may expect at best occasional good roads, which will serve only the needs of those who pay for them, while the poorer or less enterprising communities which may lie on either hand will do little or nothing to improve the roads. The principle of the "State-aid plan" is worthy of strong commendation to the States of the Middle West, but not to the exclusion of all other means of securing road betterment. While in any case competent State supervision seems necessary to insure uniformity, and to establish at least a minimum standard for roads, there may be at the same time provision in the road laws of each State permitting localities, counties, or districts to provide for highway construction by direct taxation, issuance of bonds, private subscriptions, or other means, and to build or contract for building their roads under general State supervision.

Illinois, by legislative enactment, has named a commission to inquire into road conditions in the State, and also into the merits of the State-aid plan, and if it is approved to prepare a bill embodying the principles thereof and making the same applicable to the conditions in that State, and to report the same to the next general assembly. The platforms of both political parties in the State of Iowa in the last campaign contained planks favoring this modern road legislation. The good-roads associations of the States of Arkansas and Minnesota, strongly supported by popular sentiment, have prepared, and will submit to their respective State legislatures, measures embodying the essential features of this modern road legislation. Other States are contemplating similar action.

ANTIQUATED METHODS.

The system under which the public roads are managed in the States of the Middle West is antiquated and wasteful, each year repeating the experience of the one before in expenditure of money and labor with no permanent good accomplished. The sum of money practically wasted under present methods in the attempt to maintain passable roads would cause alarm in any other business of such proportions, public or private, and would call for the most radical and prompt reform.

There are in the State of Iowa 100,257 miles of public roads, including 1,039 miles of macadam and gravel roads, the remainder being common earth roads, of which about one-fourth are principal roads. These roads, judging from the last year's expenditure, cost the people of the State the sum of $2,650,000 annually. With the exception of the 1,039 miles of improved roads, of which there is no complaint,

every year there are periods of at least three months' duration when these roads are very bad, at times almost impassable. For the past two years a season of good roads has been the exception in that State. During the winter and spring of 1903, movement of grain and other products from the farms to the elevators and stations was almost suspended for weeks at a time.

Missouri has a total road mileage of 89,946 miles, of which 1,262 miles are macadam, gravel, or slag roads (Pl. LVI, fig. 1), while the remaining portion are the natural dirt roads common to the section. The people of the State spend about $1,660,000 on the roads and highways, and as a result they have rough, bad roads in a large part of the State all the time, and muddy, nearly impassable roads at least one-third of the year. This showing for Iowa and Missouri fairly illustrates the methods and results under the present management of roads and highways in the other States of the Middle West. If the money and labor expended each year on highways without permanent results were used under competent State supervision, it would revolutionize road making in these States and bring astonishing results within a few years.

ROAD LAWS AND CONDITIONS IN SEVERAL STATES.

The road laws of the States of the Middle West as a rule follow the old-time models, with here and there special acts permitting the construction of permanent roads by petition at the cost of the owners of abutting property. In some instances the county or township boards having charge of road matters may macadamize or surface a particular piece of road or a strip that is extremely bad, provided they can defray the cost from the general road fund. In some cases enactments enable the township and the county to share with the adjoining property the cost of the construction of some special stretch of highway. Though there are such exceptions as those just noted, still the old-time slovenly and wasteful methods are in use in most of the road districts, including the old feudal method of ordering out the hands to work the roads, generally under an inexperienced and incompetent overseer. There is probably no other feature which has done so much to maintain the low state of road making as the forced-labor system. It has bred a shiftless method of work which has led our people to look upon road building as a farce. There is no situation in which the citizen makes so unsatisfactory an appearance as when he is endeavoring to make the least possible amount of labor count as a day's work on the highways of his district. Iowa by a recent law has enlarged her road districts to the limits of her township lines, abolishing the forced-labor system, and requiring all road taxes to be paid in money. This is a most commendable step. The new law will create a substantial road fund in all the counties in the State, and if the next legislature will follow this with enactments under which this money may be properly

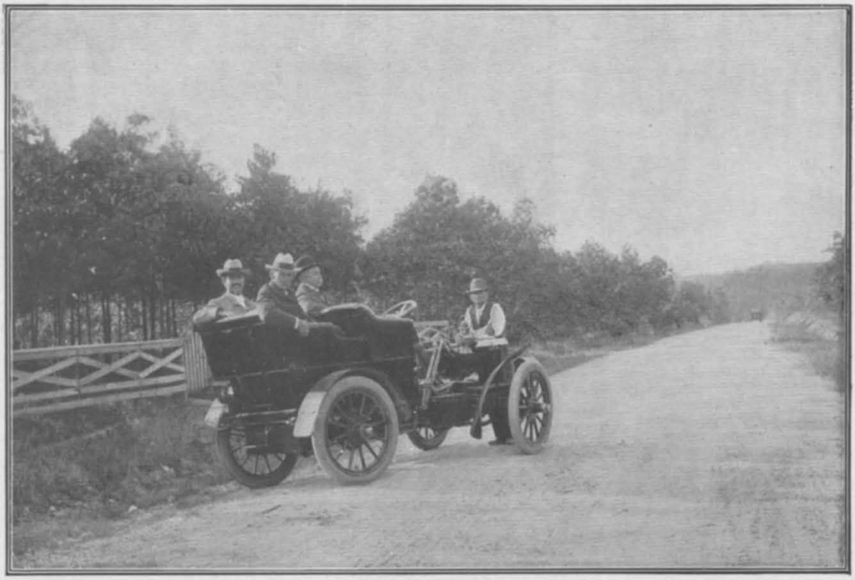

FIG. 1.—THE JOPLIN, MO, SPECIAL ROAD DISTRICT COMMITTEE INSPECTING THE FINE ROADS CONSTRUCTED OF MINING SLAG UNDER THEIR SUPERVISION.

[There are about 100 miles of these roads, built at a cost of about $150,000.]

FIG. 2.—JUNCTION OF CHESTER LEVEE AND BEMIS ROADS, NEAR JACKSON, TENN.

[This road was built of novaculite gravel, shipped from quarries in Illinois by Samuel Lancaster, city engineer, at a cost of $3,500 per mile.]

and intelligently expended we shall see a beginning made in road improvement in that State.

Missouri devotes a portion of her saloon-license moneys to the permanent improvement of the highways, and a few counties are making favorable progress in permanent road extension. There are ample provisions in her statutes for the building of macadam roads, their principal defect being that they require a petition from a majority of the abutting landowners, upon whom is laid the entire burden of cost of the improvement.

Owing to the large area of rich, deep alluvial soil, Illinois is said to have worse road conditions in wet seasons than any other State in the Union. Good materials for making roads are not very liberally diffused over the State, and it has not yet solved the difficulties of highway improvement. A large share of her $346,000,000 worth of farm products raised annually must be hauled through the mud. It is confidently expected that the new commission already referred to will present to the next legislature a road measure which will receive its approval and thus inaugurate a State system for the improvement of the highways. A recent enactment provides for the preparation of road material in the State penitentiaries for use by the counties.

There are large deposits of a gravel, known as "novaculite," in the southern portion of Illinois, which is an excellent road-making material. The streets of the city of Jackson, in Madison County, Tenn., are paved with it, and the county has constructed about 7 miles of public road of the same material (Pl. LVI, fig. 2). This mileage will be extended at the opening of the spring season, as the county has arranged for the issuance of bonds for some $300,000 for the improvement of its roads. About 1,000 yards of road constructed of this material was built at Jackson by the operators on the Illinois Central good-roads train in the spring of 1901. It has endured heavy and constant travel and traffic, and is at this date in perfect condition, having so far required no repairs. There is no road-making material within considerable radius from Jackson, while a deep alluvial clay soil similar to the black soil of Illinois has to be dealt with in road making. They prepare the foundation by proper grading and thorough rolling with a steam roller. The first course, which is of common river gravel, is shipped in from a distance of 60 or 75 miles. This is put on about 4 inches thick and rolled down to about 3. Then a layer of about 4 inches of novaculite is spread on and rolled to about 3 inches, making the full thickness of the roadbed about 6 inches. These roads are constructed with easy grades, 12 to 16 feet in width, and at an average cost of about $3,000 per mile. It is a singular fact that, while Illinois complains of lack of material, Tennessee can buy and ship road material from that State and build durable roads on a similar soil, and that within a reasonable cost.

Kansas has built a number of miles of macadam roads in the vicinity of her penitentiary by utilizing her convict labor. Special road laws authorize counties and districts to construct permanent roads, and provide that their cost shall be equitably prorated upon the county, the road district, and the abutting property.

The friends of road improvement in Minnesota are much encouraged over the passage by their senate of a bill providing for a State board of highway commissioners, and for a State tax of one-twentieth of a mill (in addition to the general road tax) to be used in paying one-third of the cost of road improvement by the State, the remainder to be paid by the counties and local districts. The main highways are to be under the control and supervision of this board. It is expected that this bill will become a law at the next session of the legislature. There is a limited mileage of substantial and beautiful macadam and gravel roads in this State, especially in the counties of Hennepin and Ramsey, in which are situated the cities of Minneapolis and St. Paul (Pls. LVII and LVIII). There are fine quarries of granite, limestone, and slate rock, all very good material, in various parts of the State. An excellent quality of gravel is plentiful along the numerous streams and is frequently found in extensive deposits. Minnesota, like the Dakotas, Nebraska, and Kansas, has an advantage over some other States by reason of the vast area of level prairies, with a kind of soil which compacts well and affords perfect natural roads for nearly all the year. But in long wet seasons they become indescribably bad, and frequently impassable. With such natural road advantages, these States could build under State cooperation surfaced roads alongside nature's roads and have ideal highways at all seasons.

Arkansas presents every variety of road condition, from the mountainous and rugged to the level and swampy. She has every kind of road-making material in abundance, and well distributed. The State is making creditable progress in road building, and the last legislature considered with favor a State-aid measure similar to the New York law. It was introduced too late in the session for final action, but it seems reasonably certain to become a law at the coming session.

ROAD MATERIAL.

A quality of limestone rock similar to that of which the excellent turnpike roads of Kentucky, Tennessee, southern Ohio, and Indiana are constructed is widely scattered over the States of the Middle West, and nearly all the macadam roads are built of this class of rock with satisfactory results. Trappean rock is found in southern Missouri and Arkansas. There are rocks with fine road-making qualities in all the States, but not generally distributed. Gravel, limestone, mining slag, and other materials may be expected to lie immediately contiguous to the roads or to require at most a short haul by rail or water. Experiments have been made with burnt or vitrified clay or ballast

OSSEO GRAVEL ROAD, 3 YEARS OLD, 4 MILES NORTH OF MINNEAPOLIS.

OSSEO MACADAM ROAD, 5 YEARS OLD, 3 MILES NORTH OF MINNEAPOLIS.

with some promise of success. There are no oil roads in this section, and it is not believed that they could be made successful, on account of adverse soil and climatic conditions.

Large areas of the broad lands of the Mississippi Valley are without any road material. This renders road making more difficult and expensive. But as a rule it will be found that the increased cost of material is offset by the lessened expense of grading, on account of the level character of the lands. It is the rare exception when satisfactory road material can not be secured where desired at a price to justify its transportation, either by rail or by water. In the writer's work in these States, involving careful investigation and study of the conditions, he has not yet found an obstacle to highway improvement which could not be overcome by the application of earnest, intelligent effort.

ROAD CONSTRUCTION.

The science of road building, as evolved from long experience in the countries of Europe and in many of our older States, is applicable to the conditions in the Middle West. In fact they are in position to profit by the experience of other States, to take advantage of modern machinery and processes, and to build highways with much greater rapidity and at much lower cost. In this connection, it may be stated that it is impossible to gather any data that will yield an accurate idea of the cost of building macadam or gravel roads. There is such a small aggregate mileage of improved roads in this part of the country, and the construction has been under such diverse conditions, that any positive statement of cost would be misleading and tend to confuse rather than to inform.

The following statement from Mr. George W. Cooley, county engineer of Hennepin County, Minn., will give some practical ideas as to construction and cost.

We have built in this county about 150 miles of gravel and 10 miles of macadam roads in the past five years. Our gravel roads are 10 to 16 feet wide, 6 to 8 inches thick, and cost $700 to $2,000 per mile, depending on distance material is hauled.

We put on our gravel roads from 18¾ to 30 cubic yards per station of 100 feet, or 1,000 to 1,700 cubic yards per mile. We do not roll the roads until they are from one to three months old, preferring to consolidate by travel and roll when settled by traffic.

Some items of cost are as follows:

	Per cubic yard.
Gravel in pit	$0.10
Loading	.10
Hauling	.25
Distributing and dressing road	.10
Total per cubic yard delivered on work	.55

This makes the cost $550 to $935 per mile for one-mile haul.

Our macadam roads are built 12 to 18 feet wide and cost $3,000 to $5,000 per mile. They are constructed as follows: One layer of 2-inch broken stone 4 inches thick, watered and rolled; then 2 inches of gravel binder, watered and rolled; then 4 inches of broken stone, 1 to 1½ inches in size, watered and rolled; then 2 inches of gravel for wearing surface, watered and rolled.

Technical knowledge of the method of construction and estimated costs of the different elements of the work may be easily obtained from bulletins issued by the Office of Public Road Inquiries, and from several engineering works upon the subject found in public libraries.

A FEW SUGGESTIONS.

It is desirable for many reasons to preserve the natural dirt road alongside and parallel to the surfaced road where possible.

It seems wise to recommend, particularly for level country where material is scarce, the building of macadam and gravel roads from 8 to 10 feet wide. Some will say: "These roads are not wide enough. How will two loads of hay pass on an 8-foot road?" The answer is: "Two loads of hay seldom meet; usually both are going to the same market at about the same time; so it is useless to construct a road to meet a condition which seldom arises." Of course, these widths are only for strictly country roads, upon level lands where it is easy to turn out. On main highways, where travel is extensive, a width of at least 16 feet should be maintained.

In these States it might be well that the vagrancy laws should have stricter enforcement, and that tramp and prison labor be employed upon the roads and in the preparation of material.

A common but erroneous impression prevails that when a road is once macadamized, graveled, or surfaced with any hard material, it is then finished and must endure for ever. An improved road needs constant attention, and unless this is given in a systematic manner like the railroads the road will rut, ravel, disintegrate, and go to ruin. Railroads build and ballast their roadways to the highest standard of perfection, then employ section men to keep up every mile.

EDUCATIONAL WORK.

The Office of Public Road Inquiries has done a great deal of experimental and educational work in the States of the Middle West. A number of object-lesson roads have been constructed under direction of expert road engineers sent out by the Department of Agriculture. Schools of instruction, or conventions, have been held in connection therewith. Much of the present interest awakened is the result of these efforts. Many bulletins treating the different phases of the road subject in a practical and instructive manner have been freely distributed to individuals showing interest. But there is still a great deal of work to be done in the way of education and experiment to make the people acquainted with the science and art of highway building, so that they will appreciate the fact that good roads mean much in the social, religious, and intellectual development of their communities, and rest upon a deeper foundation even than the demands of commerce and agriculture.

CONSUMPTION OF COTTON IN THE COTTON STATES.

By J. L. Watkins,
Cotton Expert, Bureau of Statistics.

BEGINNING OF MANUFACTURE OF COTTON.

The South began the manufacture of cotton at a very early date, and, although Beverly, Mass., is credited with the distinction of building the first cotton mill in the United States (1787), the historical records of South Carolina show that during the same year a small mill was erected on James Island, near Charleston. Three years later (1790) a mill was put in operation near Statesburg, S. C., equipped with "ginning, carding, and other machines, driven by water, and also spinning machines with 84 spindles each, with every necessary article for manufacturing cotton." [a]

EARLY DOMESTIC MANUFACTURE OF COTTON.

Prior to 1787 the domestic manufacture of cotton, stimulated by the results of the Revolution, was extensively carried on among the Southern planters. Thomas Jefferson, in a letter to M. De Warville in 1786, says: "The four southernmost States make a great deal of cotton. Their poor are almost entirely clothed in it in winter and summer." [b]

There are no trustworthy statistics showing the domestic consumption of cotton in the Southern States during the first half of the past century, but it is quite certain that practically the entire slave population, as well as the poorer class of whites, continued, as during the period alluded to by Mr. Jefferson, to be clothed in homespun cotton. Even at the beginning of the civil war almost every well-regulated plantation in the South had its equipment of spindles and cards and looms. The same may be said of the homes of the poorer white people of those days. Just how much cotton was consumed in this manner is unknown. In 1800 the production of cotton in the United States was estimated at 35,000,000 pounds, of which 17,800,000 were exported. The quantity manufactured in the whole country exceeded 8,000,000 pounds, or, say, 35,555 bales (225 pounds each), only about "500 of which were consumed in regular establishments." [c] As the "regular

[a] Bishop's History of American Manufactures.

[b] Jefferson's Writings, edited by H. A. Washington.

[c] Gallatin's Report on American Manufactures, April, 1810.

establishments" alluded to were located in the New England States, about 7,887,000 pounds must have been consumed in the domestic manufactures of the Southern States.

HOUSEHOLD MANUFACTURES IN 1810.

In regard to household manufactures in 1810, Gallatin says that by far the greater part of the cotton, flax, and woolen goods was manufactured in private families, mostly for their own use and partly for sale. "The articles made were principally coarse cloth, flannel, cotton stuffs and stripes of every description, linen, and mixtures of wool with flax and cotton. Information received from every State showed an extraordinary increase during the last two years, and rendered it probable that about two-thirds of the clothing, including hosiery, house and table linen, worn and used by the inhabitants of the United States outside of the cities, was the product of family manufactures." In the lower counties of Virginia, throughout North Carolina, and in the upper counties of South Carolina and Georgia, almost the whole summer clothing of all classes was of household manufacture, and the slaves were entirely clothed in that manner. In illustration of the common use of homespun at this period it is stated that of 1,500 persons attending a militia review in North Carolina, less than 40 wore anything but homespun.[a] Statistics also show that in 1810 the manufactured products of Virginia, the Carolinas, and Georgia exceeded in quantity and value those of all the New England States. Georgia, with a white population of 145,414 persons, manufactured in 1810 more yards of various cloths and stuffs than Rhode Island with all of its manufacturing establishments. In Virginia, the cotton goods of household manufacture amounted to 3,007,255 yards; in North Carolina, to 7,376,154 (blended cloths); in South Carolina, to 3,083,188; in Georgia, to 3,688,534; in Tennessee, to 1,790,514; in Mississippi, to 342,472; and in Louisiana to 133,180. In addition to this, 1,272,322 yards of mixed cotton goods were manufactured in Virginia and 108,627 yards in South Carolina. In Georgia 3,148 yards of cotton goods were manufactured in cotton mills.[b]

EFFECT OF THE EMBARGO ON DOMESTIC MANUFACTURES.

The embargo laid upon foreign commerce during Jefferson's and Madison's Administrations, and which resulted in such a remarkable development of the cotton industry in the New England States, also had a stimulating effect in the South. The South Carolina Homespun Company, with a capital of $30,000, was organized at Charleston (1808) to promote the manufacture of common domestic fabrics, and 4,000 people attended the laying of the corner stone of "the first edifice on

[a] Bishop's History of American Manufactures.

[b] Digest of Manufactures, Report of Secretary of Treasury to Senate, January, 1814.

a large scale, in that part of the Union, devoted to domestic manufacture."[a] Two years later the Union Manufacturing Company, of Maryland, incorporated with a capital of $1,000,000, erected two cotton mills, run by water power, on the Patapsco River, 10 miles from Baltimore, and adjoining the mills owned by the Ellicotts. The year following (1811) the Washington Manufacturing Company, with $100,000 capital, built a water-power mill 5 miles from Baltimore, at Jones Falls. The same year (1811) a cotton mill was built on Upton Creek, in Wilkes County, Ga.

MANUFACTURING IN THE SOUTH DISCOURAGED.

But in spite of the occasional building of a cotton mill, manufacturing was not encouraged by many of the leading citizens of the South. Early in his career Mr. Jefferson had discouraged it, believing that the people would be happier, more virtuous, and prosperous in the pursuit of agriculture than they could be with the vices and evils of manufacturing towns in their midst.[b] The tariff laws then in force intensified the opposition to this branch of industry, and John Randolph, in a speech in the House of Representatives (April, 1824), declared that if there was no other obstacle the climate was against it; and, that if we were to build up manufactures on the English system we should have yellow fever "not in August merely, but from June to January and from January to June." When the foundation of a cotton mill was laid at Moore's Mill, near Athens, Ga., in 1827, the editor of the local paper, in noting this important event, says:

> A sense of safety and independence combined, doubtless, with an expectation of profit has urged gentlemen to an undertaking against which their political convictions are at war. And we are authorized to state that these sentiments have by no means undergone a change; that their project is certainly not to give countenance to a system which they have always denounced, but it is to be regarded as a measure unquestionably defensive.

Later on, the project for a manufacturing company with joint stock, incorporated and privileged by the State of Maryland, was very much opposed; and the doctrine that it was better to buy of Europe and India was widely spread.[c]

COTTON MANUFACTURING ESTABLISHMENTS, 1800–1820.

During the twenty years, from 1800 to 1820, inclusive, there had been incorporated under existing State laws in the Southern States 42 cotton mills. Eleven of these mills were in Maryland, 3 of which

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[a] Bishop's History of American Manufactures.

[b] Jefferson's Notes on Virginia. Mr. Jefferson subsequently changed his views on this subject. In 1816, in a letter to Benjamin Austin, of Boston, he writes: "Experience has taught me that manufactures are now as necessary to our independence as to our comfort."

[c] White's Memoir of Slater, 1836.

manufactured cotton yarns, 1 cotton twist, and 7 piece goods, cotton checks, stripes, plaids, tickings, shirtings, and sheetings. Three mills in Virginia, 1 in North Carolina, and 3 in South Carolina spun cotton yarns. In Georgia 1 mill made cotton cloths; and in Tennessee 3 mills made shirtings, sheetings, cassinets, and other cotton fabrics, 1 cotton yarns, and 1 cotton rolls. In Kentucky there were 18 mills—13 of which made cotton yarns, 1 cotton bagging, and 4 cotton cordage, cassinets, and mixed cotton and woolen goods.[a]

The returns of the Fourth Census (1820), which did not include any manufactures of a domestic or household character, give the number of spindles and pounds of cotton annually spun in each of the Southern States as follows:

Maryland, 20,245 spindles, cotton spun, 849,000 pounds; Virginia, no spindles, cotton spun, 3,000 pounds; North Carolina, 288 spindles, cottton spun, 18,000 pounds; South Carolina, 588 spindles, cotton spun, 46,449 pounds; Kentucky, 8,097 spindles, cotton spun, 360,951 pounds—total spindles, 29,218, and cotton spun, 1,277,400 pounds, or, say, 4,839 bales of 264 pounds each.[b]

THE COTTON INDUSTRY FROM 1830 TO 1860.

During the thirty years from 1830 to 1860 very little is known as to the progress of the cotton industry in the Southern States. Leaving out Maryland, the census of 1840 reported 248 mills, having 180,927 spindles, no estimate being made of the amount of cotton consumed. But the report relating to this industry must have been very defective, for the number of mills in Mississippi was returned as 53, while the number of spindles given was only 318. Likewise, Alabama was reported to have 14 mills with only 1,502 spindles. There are no records showing the existence of a single mill in Mississippi equipped with then up-to-date machinery, while in Alabama there were only two such mills. Assuming, however, the correctness of the report as to the number of spindles, 180,927, the consumption of cotton at this time must have approximated 75,000 bales.

During the decade 1830–1840, about 36 cotton mills were constructed; 37 during the decade 1840–1850; and 10 during the decade 1850–1860.

THE CONSUMPTION OF COTTON IN SOUTH CAROLINA.

South Carolina is entitled not only to the distinction of ranking first among the Southern States in the manufacture of cotton, but as being the first to undertake its manufacture. It is said that the historical records of the State contain an account of the building in 1787 of a

[a] Report on Manufactures, Senate Document No. 45, Eighteenth Congress.

[b] The reports of this census relating to manufactures were so imperfect that an effort was made in Congress to suppress them.

PLATE LIX.

GRANITEVILLE COTTON FACTORY, NEAR AIKEN, S. C., FOUNDED BY WILLIAM GREGG, ESQ., 1846.

Yearbook U. S. Dept. of Agriculture, 1903.

small horsepower mill on James Island, near Charleston, by Mrs. Ramage, the widow of a Carolina planter. In 1790 a factory, run by water power, was put in operation near Statesburg. In 1807 unusual interest was manifested in this branch of industry, and efforts were made to establish small factories and to introduce upon plantations the manufacture of cotton goods for negro wear and of cotton blankets. Two years later (1809) cotton goods were manufactured in Union district and cotton blankets in Prince William district. About this time "a factory for making check goods and handkerchiefs was established at Charleston, which turned out some very pretty goods."[a] According to a report of the Secretary of State, in 1824, three cotton-yarn mills were incorporated under the State laws between the years 1800 and 1820, two of which were located in Greenville County and the other in Spartanburg County.

In 1829 the second cotton mill in the State, run by other than horse-power, was erected at Pendleton, and at Autun, in the same neighborhood, another such mill was built in 1838. In 1846 a mill was built at Graniteville. It was then the largest in the State and contained 8,400 spindles and 300 looms and made No. 14 yarns and 4-4 wide sheeting, 7-8 shirtings, and 7-8 twills. (Pl. LIX.)

In 1848, in addition to the above, though the date of their building is unknown, the following mills were in operation: The Saluda Cotton Factory, near Columbia, (which employed all negro operators, except a white overseer, operated 5,000 spindles and 120 looms, and made heavy brown shirtings and Southern stripes—a coarse kind of colored goods for house servants); the De Kalb, near Camden; the Vaucluse, in Aiken County; the Mount Dearborn, on the Catawba River, in York County; a small mill at Society Hill, in Darlington County, and the Marlborough yarn mill[b] (location not given). Two other mills were in process of construction, one of which, at Charleston, having 3,165 spindles and 100 looms, and run by steam power, was put in operation in 1849. The following year (1850) a mill was built at Arlington, in Spartanburg County. So far as the records show, no new mills were built in the State from 1851 to the beginning of the civil war.

As to the consumption of cotton in South Carolina prior to 1840 little or nothing is known. The census of 1820 reported 588 spindles in operation and consuming 46,000 pounds of cotton, but the next census (1830) made no reports upon this industry. In 1840 there were 15 mills in the State, operating 16,355 spindles and consuming approximately 6,150 bales of cotton. The progress of the industry since 1850 is shown in the table on the next page.

It was not, however, until about 1884–85 that the cotton-mill industry

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[a] De Bow's Review, Vol. VIII.

[b] Hunt's Magazine, Vol. XVIII.

of the State began its remarkable development. The next census (1890) was a surprising revelation, showing that in ten years the number of mills had more than doubled, the number of spindles more than quadrupled, and that the amount of cotton consumed was very little short of four times as great. The progress of the industry since 1890 is even more wonderful, the number of mills having increased from 34 to 136, the number of spindles from 332,784 to 2,479,521, or 645 per cent, and the number of bales consumed from 133,342 to 587,126, or 340 per cent. It will be noticed that the per cent of the crop consumed increased from 17.8 in 1890 to 63.4 in 1902-1903.

Consumption and production of cotton in South Carolina, 1850-1903.

Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.	Per cent of crop used.
1849-50	18	36,500	9,929	300,901	3.3
1859-60	17	30,890	8,648	353,412	2.4
1869-70	12	34,940	10,811	224,500	4.8
1874-75	18	70,282	19,945	360,000	5.5
1879-80	14	82,424	33,624	522,548	6.4
1884-85	31	217,761	77,451	511,800	15.1
1889-90	34	332,784	133,342	747,190	17.8
1890-91	44	415,158	164,814	859,000	19.2
1891-92	47	467,825	183,625	780,000	23.5
1892-93	51	503,269	200,219	635,000	31.5
1893-94	50	569,033	215,228	650,000	33.1
1894-95	48	619,849	229,580	862,604	26.6
1895-96	58	802,854	257,700	764,700	33.7
1896-97	73	1,056,198	297,782	936,463	31.8
1897-98	76	1,205,272	398,456	1,030,085	38.7
1898-99	80	1,285,328	466,181	1,035,414	45.0
1899-1900	93	1,693,649	489,559	830,714	58.9
1900-1901	115	1,908,692	501,290	743,294	67.4
1901-2	127	2,246,926	607,906	843,660	72.1
1902-3	136	2,479,521	587,126	925,490	63.4

THE CONSUMPTION OF COTTON IN NORTH CAROLINA.

North Carolina, which now ranks second among the cotton-consuming States of the South, was the third one to engage in the manufacture of cotton, its first mill having been erected at the Falls of Tar (or Pamlico) River, in Edgecombe County, in 1818. It began operating with 288 spindles, employed about 20 hands, and consumed 18,000 pounds of cotton, or, according to the weights of those days, about 64 bales. Two years after this mill began operations another was built (1822) on the Catawba River, near Lincolnton. In 1829, or about that date, a mill, run by steam power, was erected at Greensboro. It operated 3,000 spindles and 75 looms, and made sheetings, shirtings, osnaburgs, and yarns.

FIG. 1.—ALAMANCE COTTON MILL, ALAMANCE COUNTY, N. C., FOUNDED BY EDWIN M. HOLT IN 1837.

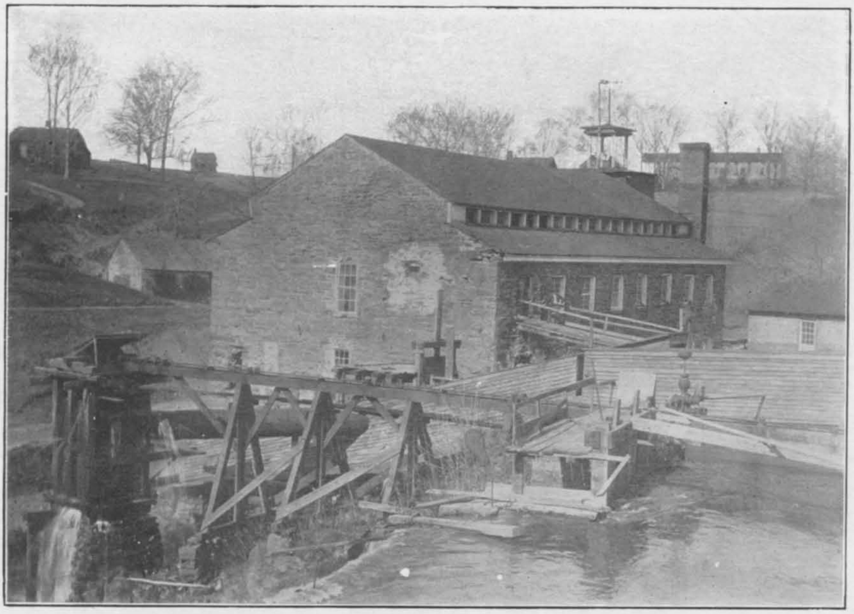

FIG. 2.—LEAKSVILLE COTTON MILL, ON DAN RIVER, SPRAY, N. C., BUILT IN 1839.

FIG. 1.—CEDAR FALLS COTTON MILL, RANDOLPH COUNTY, N. C., BUILT IN 1848.

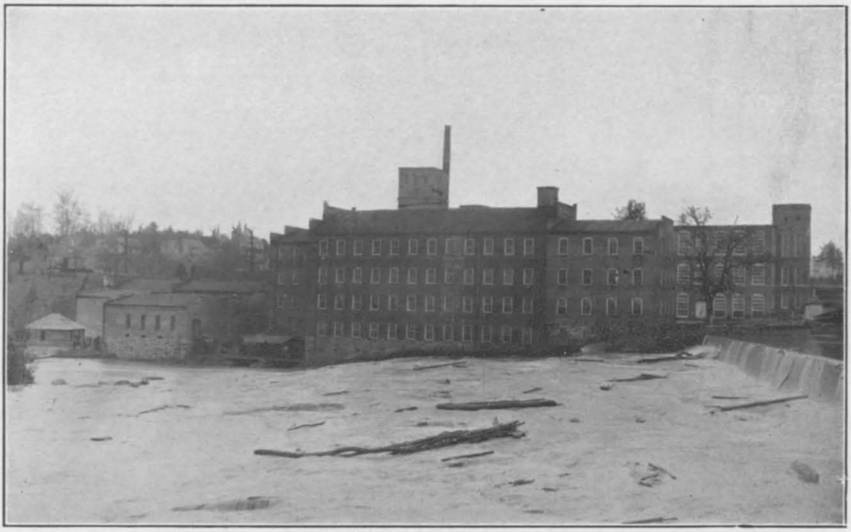

FIG. 2.—HIGH SHOALS COTTON MILL, ON APALACHEE RIVER, OCONEE COUNTY, GA., AS IT APPEARED IN 1844, BUILT BY JACOB KLUTTS.

The first of a number of mills in Cumberland County was erected at Fayetteville in 1836. The following year (1837) a mill was built at Rockingham. It was burned during the civil war and rebuilt in 1870. A mill at Cumberland and one on Alamance Creek, in Alamance County, were also erected during this year (1837). The latter, equipped with 528 spindles and 16 looms, was founded by the late Governor Edwin M. Holt, and is said to have been the first mill south of the Potomac River to manufacture colored cotton goods. (Pl. LX, fig. 1.) Besides the above, the records show 3 other mills in operation at this time—1 at Mocksville, Davis County, and 2 in Alamance County, one of which was at Haw River and the other at Cane Creek.

In 1838 the second mill was put in operation at Fayetteville, and one at each of the following places: Wittenberg, Alexander County; Lexington, Davidson County (run by steam power); High Falls, Orange County. Some time between 1838 and 1843 four more mills were erected in the vicinity of Fayetteville. The 6 mills then operating near this place were estimated to have cost $350,000. Three of these mills manufactured stout brown sheetings, another osnaburgs weighing one-half pound to the yard, and the other two yarns only.

A mill was built in 1839 at Spray (Pl. LX, fig. 2), and in 1842 one was constructed at Cedar Falls (Pl. LXI, fig. 1). Besides the mills already enumerated, though in what year they were constructed is unknown, the following mills are said to have been in operation in 1844: The Salem Factory, in Stokes County (run by steam power); a mill at Franklinville, Randolph County; 1 at Salisbury; 1 at Concord; 1 at Milton, Caswell County; and 1 at Milledgeville, Montgomery County. It was estimated that the 25 mills in the State represented a capital of $1,050,000, operated 50,000 spindles, employed from 1,200 to 1,500 hands, and consumed 15,000 bales of cotton.[a]

In 1845 a mill was erected at Haw River, in Alamance County, and in 1848 another was built on the Yadkin River at Elkin, Surry County. The following year (1849) a mill at Saxapahaw, Alamance County, and another at Salem, Forsyth County, were put in operation; also a mill at Ramseur, 1850; 1 at Willardville, 1852; 1 at Mountain Island, 1856; and 1 at Hope Mills, 1860.

Little is known as to the consumption of cotton in North Carolina prior to 1840. According to the census returns for 1820, there were only 288 spindles in operation, which consumed 18,000 pounds of cotton. The next census (1830) made no reports upon this industry. In 1840 there were about 25 mills in the State, operating 47,934 spindles, which consumed, approximately, 20,450 bales. The progress of the industry since 1850 is illustrated in the table on the next page.

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[a] Hunt's Magazine, Vol. X.

Consumption and production of cotton in North Carolina, 1850–1903.

Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.	Per cent of crop used.
1849–50	28	40,000	13,617	73,815	18.4
1859–60	39	41,884	12,015	145,514	8.3
1869–70	33	39,897	9,632	144,935	6.6
1874–75	31	51,500	14,428	273,000	5.3
1879–80	49	100,209	27,642	389,598	7.1
1884–85	75	206,172	54,478	404,100	13.5
1889–90	91	337,786	114,371	336,261	34.0
1890–91	105	418,900	140,817	588,000	23.9
1891–92	112	475,733	161,052	480,000	33.6
1892–93	125	543,809	182,647	367,000	49.8
1893–94	131	538,486	176,179	400,000	44.0
1894–95	135	612,503	221,264	479,441	46.2
1895–96	133	773,030	219,822	397,752	55.3
1896–97	152	884,678	245,177	521,795	47.0
1897–98	161	919,227	334,873	646,726	51.8
1898–99	169	1,003,268	374,891	629,620	59.5
1899–1900	190	1,264,509	442,508	503,825	87.8
1900–1901	218	1,428,066	408,333	554,032	73.7
1901–2	229	1,682,272	509,486	599,668	85.0
1902–3	236	1,796,390	531,255	549,542	96.3

The census of 1890, as in the case of South Carolina and Georgia, gave surprising evidence of the rapid growth of the cotton industry, showing that in ten years the number of mills had increased from 49 to 91, the number of spindles from 100,209 to 337,786, and the number of bales of cotton consumed from 27,642 to 114,371. From 1890 to the present time the industry has continued in a career of remarkable development, the number of mills having increased from 91 to 236, or 158 per cent; the number of spindles from 337,786 to 1,796,390, or 432 per cent; and the number of bales of cotton consumed from 114,371 to 531,255, or 363 per cent. The per cent of the crop taken for domestic consumption has increased from 23.9 per cent in 1890–1891 to 96.3 per cent in 1902–1903.

THE CONSUMPTION OF COTTON IN GEORGIA.

Georgia, now third in importance, was second among the Southern States to begin the manufacture of cotton. As early as 1798 a cotton mill was incorporated, but there is no record to show that any organization under the charter was perfected. In 1809 there was a small horsepower mill in operation at Louisville.

But the first cotton mill of any consequence in the State was known as the "Bolton Factory," and was built in 1811, on Upton Creek, 9 miles southeast of Washington, in Wilkes County. It was 60 feet by 40, two stories, attic, and basement, and was constructed of brownstone.[a] (Fig. 49.)

[a] M. F. Foster, Address before New England Cotton Manufacturers' Association, 1900.

In March, 1827, the foundation of a mill, with 1,000 spindles and 30 looms, was laid at Moore's Mill, 4 miles from Athens. This was the second in the State run by other than horsepower. In 1828 four cotton mills are said to have been constructed and put in operation—1 at Augusta, 2 at Milledgeville, and 1 at Indian Springs, in Butts County. A mill was also built at Athens in 1834.

In 1837 a mill was in operation at Columbus, and in 1839 one was built at Roswell. In 1846 two mills were constructed -one at Troup Factory and the other at Waynmanville.

In 1840 there were 19 cotton mills in operation in Georgia, operating 42,589 spindles and consuming approximately 18,150 bales of cotton. A cotton mill as it appeared in 1844 is shown on Pl. LXI. Prior to 1840 there are no reliable statistics of the amount of cotton consumed.

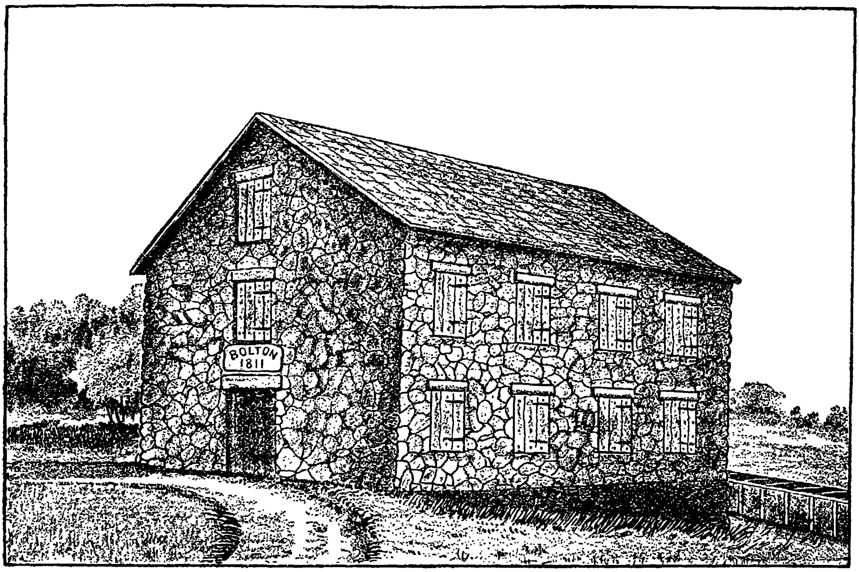

FIG. 49.—"Bolton Factory," the first cotton mill in Georgia—built on Upton Creek, Wilkes County, in 1811.

Donnell[a] estimated the consumption in 1848–49 at 20,500 bales, and in 1849–50 at 27,000 bales.

In 1850 a mill was built at Jewell, in Hancock County. Three mills are said to have been in operation this year (1850) at Columbus—1 with 2,500 spindles, which manufactured heavy osnaburgs; 1 with 10,000 spindles; and 1 which contained 5,000 spindles and manufactured osnaburgs and sheetings, and consumed 1,200 bales of cotton.[b]

The first of the mills which have made Augusta so prominent as a cotton manufacturing center was erected in 1858. A mill was built in 1860, at Shoal Creek, in Hart County.

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[a] History of Cotton.
[b] Hunt's Magazine, Vol. XXIII.

The progress of the industry since 1850 is shown in the following table:

Consumption and production of cotton in Georgia, 1850–1903.

Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.	Per cent of crop used.
1849–50	35	51,150	20,230	499,091	4.1
1859–60	33	85,186	30,235	701,840	4.3
1869–70	34	85,062	24,821	437,934	5.7
1874–75	47	131,340	50,214	460,000	10.9
1879–80	40	198,656	71,389	814,441	8.8
1884–85	53	349,277	99,414	807,400	12.3
1889–90	53	445,452	145,859	1,191,846	12.2
1890–91	62	465,811	164,981	1,310,000	12.6
1891–92	57	495,564	178,944	1,200,000	14.9
1892–93	59	500,408	187,702	940,000	20.0
1893–94	63	515,712	176,303	1,000,000	17.6
1894–95	61	551,806	218,685	1,247,952	17.5
1895–96	62	607,251	200,636	1,067,377	18.8
1896–97	76	683,407	227,831	1,299,340	17.5
1897–98	77	709,406	285,219	1,350,781	21.1
1898–99	79	696,394	281,527	1,378,731	20.4
1899–1900	86	969,364	318,302	1,345,699	23.7
1900–1901	107	1,016,258	356,878	1,271,573	28.1
1901–2	115	1,220,374	381,960	1,598,192	23.9
1902–3	115	1,292,695	417,871	1,425,044	29.3

THE CONSUMPTION OF COTTON IN ALABAMA.

Alabama, which ranks fourth among the Southern States as a consumer of cotton, built its first mill in 1832. It was located on the Flint River, in Madison County, 12 miles from Huntsville, was run by water power, and manufactured yarns, cottonades, ginghams, checks, and colored and plain osnaburgs. The second mill in the State was erected at Scottsville, in Bibb County. It employed 20 hands, worked 700 spindles, and was run by water power.

In answer to a circular sent out by the United States Treasury Department in 1844, making some inquiries in regard to the manufacturing, commercial, and agricultural industries, one of the replies was from a cotton mill at Tallapoosa Falls, near Tallassee, which was established about this time. It reported 30 hands, and $30,000 invested in the mill, which returned a net profit of 15 per cent. A cotton mill was in operation this year (1844) at Florence, and one is said to have been in operation in Morgan County, though there is some doubt of this.

In 1850, or about that time, a mill was constructed at Tuscaloosa, and the year following (1851) a factory, located on Swift Creek, in Autauga County, was put in operation. It contained 3,000 spindles and manufactured osnaburgs and No. 14 yarns. In 1854 a mill was erected at Tallassee. The table on the next page shows the progress of the industry since 1850.

Consumption and production of cotton in Alabama, 1850–1903.

Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.	Per cent of crop used.
1849–50	12	16,960	5,208	564,429	0.9
1859–60	14	35,740	11,406	989,955	1.2
1869–70	13	28,046	7,385	429,482	1.7
1874–75	14	58,480	14,561	520,000	2.8
1879–80	16	49,432	14,702	699,654	2.1
1884–85	17	69,308	18,802	648,700	2.9
1889–90	13	79,234	29,962	915,210	3.3
1890–91	17	89,158	30,364	1,011,000	3.0
1891–92	20	109,448	39,709	1,075,000	3.7
1892–93	22	129,776	41,409	740,000	5.6
1893–94	21	153,601	47,438	810,000	5.9
1894–95	23	163,460	54,972	900,439	6.1
1895–96	24	187,192	58,998	663,916	8.9
1896–97	31	215,004	68,658	833,789	8.2
1897–98	37	263,764	97,401	1,112,681	8.8
1898–99	38	353,052	121,128	1,176,042	10.3
1899–1900	44	437,200	154,841	1,005,313	15.4
1900–1901	49	550,966	157,832	1,021,845	15.4
1901–2	54	622,794	196,137	1,131,094	17.3
1902–3	54	694,386	201,303	956,215	21.1

THE CONSUMPTION OF COTTON IN TENNESSEE.

On a small scale Tennessee began the manufacture of cotton sometime during the first decade of the last century, as the records show that in 1809 a horsepower mill was in operation at Nashville. A year later there are said to have been 4 small mills in operation at different places in the State, though their locations are not given. There is no evidence of the building of any cotton mills during the next seventeen years, but in 1827, or about this time, a mill in Maury County, run by water power, seems to have attracted some attention, perhaps, because of the fact that it was the first regular cotton mill established in the State, and was operated by slave labor.

At this time domestic manufactures were so extensively carried on in this part of the country that a large majority of the population were clothed in homespun, and hence there was little demand for a better grade of manufactured goods. One of the domestic spinning machines in use at this period (1828) in Tennessee, and other Southern States, and which is said to have been invented by a Tennessean, is thus described:

It was 4 feet high, 3½ feet long, and 2 feet wide. At one end there was a gin of six saws, and at the other as many spindles, with a spool on each to receive the spun yarn, and in the center were placed two cylindrical cards as near each other as possible without touching. The seed cotton being put into the gin, the handle of the machine was turned by the spinner until the spools were filled, care being taken meanwhile to mend any broken threads. A woman could spin five times as much yarn as with the common wheel and cards. The number of spindles could be increased to

any desired number, but six was most commonly in use. As the machines cost only $20 per spindle they were within reach of all classes. General Jackson used one of them at the Hermitage, and with it clothed his family and servants.[a]

Not until 1840 is there any further record of the cotton-mill industry in Tennessee. The census of that year returned 38 mills operating 16,813 spindles. The consumption was not reported, but it must have approximated 6,500 bales of cotton. The second mill in the State was built at Lebanon in 1844, but it used only a small quantity of cotton—600 bales annually. It manufactured yarns and cloth, the latter consisting of heavy white and colored jeans and linseys, Saxony tweed (made from Saxony wool grown in the State), "intended for gentlemen's wear," twilled cotton bagging, tent cloth, heavy tarpaulin, and "negro blankets." The following table shows the progress of the industry since 1850:

Consumption and production of cotton in Tennessee, 1850–1903.

Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.	Per cent of crop used.	Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.	Per cent of crop used.
1849–50....	33	36,000	6,411	194,532	3.3	1893–94..	22	95,219	24,807	276,000	9.0
1859–60....	30	29,850	8,854	296,464	3.0	1894–95..	22	95,866	30,914	304,981	10.1
1869–70....	28	27,923	6,528	181,842	3.6	1895–96..	30	115,743	28,732	172,560	16.7
1874–75....	40	55,384	14,443	160,000	9.0	1896–97..	28	113,119	30,746	236,781	13.0
1879–80....	16	35,736	10,436	330,621	3.2	1897–98..	29	102,834	35,773	268,635	13.3
1884–85....	28	90,793	24,427	313,800	7.8	1898–99..	29	103,366	36,358	322,820	11.3
1889–90....	20	97,524	33,114	190,579	17.4	1899–1900	32	155,997	34,882	192,263	18.1
1890–91....	23	100,235	32,226	345,000	9.3	1900–1901	33	196,761	33,305	206,015	16.2
1891–92....	22	101,534	33,759	310,095	10.9	1901–2...	32	200,976	45,240	192,922	23.4
1892–93....	23	110,485	33,370	207,576	16.1	1902–3...	32	241,078	45,385	317,149	14.3

THE CONSUMPTION OF COTTON IN VIRGINIA.

Undoubtedly Virginia began the domestic manufacture of cotton at a very early date, perhaps as early as any of the Southern States, but the records are not clear as to the date when factory manufacturing was first established. Gallatin's report shows that in 1809 a water-power mill was in operation at Petersburg.[b] According to the report of the Secretary of the Treasury, made to the Senate in 1824, three cotton-spinning mills had been incorporated under the State laws, one in each of the counties of Bedford, Louisa, and Powhatan. But the census of 1820 did not return any mills in operation, and the consumption of only 3,000 pounds of cotton.

McGregor's Commercial Statistics enumerates 7 mills in operation in 1831, working 9,844 spindles and consuming 1,152,000 pounds of cotton, or, according to the weights of that period, about 3,185 bales. But when or where these mills were erected there appears to be no

[a] The American Farmer, 1828.

[b] Gallatin's Report on Manufactures, 1810.

record. In 1833 a site was donated and $120,000 subscribed for the establishment of a mill at Petersburg.[a] However, it is uncertain whether the project was a success. There is no doubt that a few years later two cotton mills were erected at Matoaca, on the north bank of the Appomatox River, about 4 miles from Petersburg. One of the mills went into operation in 1838; the other mill may have been in operation a year or two earlier, for one authority states that in 1836 two mills were erected at this place, and still another, that in 1837 "there were two mills located at Matoaca." The latter authority also states that in the same year there was a cotton mill in Richmond and one in Manchester, across the river from Richmond, both of which were "in full operation."[b]

In 1840 there were 22 mills in the State, operating 42,182 spindles and consuming approximately 17,700 bales of cotton. During this year a mill was erected at Petersburg. The commercial authorities estimated the consumption of cotton at this time at more than 20,000 bales. The table following shows the progress of the industry since 1850:

Consumption and production of cotton in Virginia, 1850–1903.

Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.	Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.
1849–50	27	50,000	17,785	3,947	1893–94	9	106,728	27,048	12,000
1859–60	16	49,410	16,400	12,727	1894–95	10	127,408	32,383	13,414
1869–70	11	77,116	9,671	183	1895–96	12	134,425	31,070	7,964
1874–75	9	54,624	11,985	10,967	1896–97	15	139,425	39,405	11,539
1879–80	8	44,340	11,461	19,595	1897–98	15	133,497	42,880	12,878
1884–85	11	58,649	13,556	13,500	1898–99	17	137,803	41,502	13,990
1889–90	9	94,294	22,731	5,735	1899–1900	15	165,452	44,595	8,007
1890–91	12	87,981	21,395	7,226	1900–1901	15	159,532	36,462	12,318
1891–92	12	95,532	25,240	13,984	1901–2	16	157,370	40,866	14,688
1892–93	10	100,086	25,924	9,393	1902–3	17	191,546	43,331	15,614

CONSUMPTION OF COTTON IN SEVERAL COTTON STATES.

The first cotton mill in Mississippi was erected at Natchez in 1844, and the first mill in Louisiana some time prior to 1840, as the census of that year reported 2 mills in the State. The first mill in Texas was built at Huntsville, in 1860, by the State government, and the first in Arkansas, at Cave Hill, Washington County, in 1844. Missouri began manufacturing cotton between 1840 and 1850, the census of the latter year being the first official report of any mills in that State.

Kentucky, though never a large consumer of cotton, began its manufacture on a small scale early in the last century. In 1809 there were 6 small horsepower mills in operation, and in a schedule of

[a] Farmer's Register, 1833.

[b] Montgomery. The Cotton Manufactures of the United States.

manufacturing establishments "incorporated under State laws" from 1800 to 1820, reported by the Secretary of State to the United States Senate in 1824, is a list of 18 mills, located in 15 different counties, 13 of which made cotton yarns, 1 cotton bagging, and 4 others cotton cordage, cassinets, and mixed cotton and woolen goods. The first large mill in the State was built at Covington in 1828, at a cost of $66,000.

The progress of cotton manufacturing in these cotton States has been slow, but with the exception of Missouri, each State shows substantial gains in recent years, and this is especially true of Mississippi, Texas, and Kentucky. The consumption of cotton in Mississippi has nearly doubled since 1890; in Texas it has increased from 3,301 to 20,713 bales, or more than 525 per cent; and in Kentucky, from a little less than 12,000 to 26,000 bales in 1900.

Consumption of cotton in several cotton States, 1860–1903.

States, mills, etc.	1859–60	1869–70	1879–80	1889–90	1894–95	1899–1900	1902–3
Mississippi:							
Mills	4	5	8	9	7	10	17
Spindles	6,344	3,526	18,568	57,004	55,393	88,584	139,192
Bales consumed	1,519	1,320	6,411	17,366	15,757	21,440	34,050
Louisiana:							
Mills	2	4	2	2	4	5	6
Spindles	6,725	13,084	6,096	45,101	57,828	62,222	67,252
Bales consumed	4,339	1,707	1,358	12,223	16,429	15,695	17,320
Texas:							
Mills	1	4	2	1	5	6	15
Spindles	2,700	8,878	2,648	12,056	40,420	60,876	74,816
Bales consumed	1,278	2,448	246	3,301	12,576	16,868	20,948
Arkansas:							
Mills	2	2	2	2	2	4	2
Spindles	1,000	1,125	2,015	4,331	6,148	17,160	12,112
Bales consumed	408	151	680	1,222	2,103	2,394	2,894
Kentucky:							
Mills	6	5	3	5	5	10	8
Spindles	8,192	7,734	9,022	42,942	48,600	68,730	96,388
Bales consumed	3,970	3,602	4,050	11,980	18,018	26,008	19,884
Missouri:							
Mills	2	3	3	1	1	4	2
Spindles	5,000	16,715	19,312	5,492	3,500	15,744	14,916
Bales consumed	2,152	4,992	6,399	1,385	671	3,720	4,587

THE COTTON INDUSTRY OF THE PAST TWENTY YEARS.

Remarkable events have transpired in the cotton industrial world within the past twenty years—

The United States has increased its cotton crop nearly 5,500,000 bales, or about 96 per cent:

India's crop has increased 1,500,000 bales (of 400 pounds each), or 73 per cent:

Egypt's crop has increased 570,000 bales (of 500 pounds each), or 79 per cent:

Russia, which used to draw so largely upon this country for her raw cotton, is now supplying her mills with 200,000 to 300,000 bales grown in her trans-Caspian provinces:

Brazil has almost ceased exporting cotton, such is the home demand for her crop:

The Continent of Europe has increased its consumption of cotton 2,492,000 bales, or about 95 per cent:

In the United States the consumption of cotton in the North has increased 762,000 bales, or 59 per cent; in the South, 1,607,000 bales, or 509 per cent; and in the whole country, 2,369,000 bales, or nearly 148 per cent:

The consumption of cotton in East India has increased 1,200,000 bales, or about 200 per cent, and her mills now use about one-half of the crop produced there:

Japan has erected within her little Empire mills equipped with 1,333,000 spindles, and is consuming from 600,000 to 700,000 bales of cotton annually, nearly 25 per cent of which is American cotton:

The world's consumption of cotton has increased nearly 7,000,000 bales, or about 94 per cent:

The United States, the largest producer, has also become the largest consumer of cotton, hence the price of its staple is now regulated in the home market, and no longer in Liverpool.

But, notwithstanding the great increase in the world's consumption of cotton within twenty years, the overshadowing feature of the period is the phenomenal increase in consumption in the cotton States. This is of immense significance to the countries consuming American cotton, because every additional 10,000 bales consumed in this country means shorter time for some foreign mill, perhaps its shutting down—assuming, of course, that no further expansion of the American crop and that of other countries will take place.

The table on the next page shows that in 1850 there were 168 cotton mills in the Southern States, operating 245,810 spindles and consuming 80,300 bales of cotton. In 1860 there were 2 mills less, but an increase of 58,741 in the number of spindles and 21,388 in the number of bales consumed. The first census taken after the civil war showed 154 mills in operation, having 344,046 spindles, and consuming 83,068 bales, or only 2,768 more than were consumed in 1850. Five years later the number of mills had increased to 181, the number of spindles to 481,821, or 40 per cent, and the number of bales consumed to 145,078, or 75 per cent in five years.

In 1880 the census returns showed a decrease in the number of mills as compared with 1875, but an increase of 86,637, or 18 per cent, in the number of spindles, and 43,320, or 30 per cent, in the number of bales consumed. In 1885 the number of mills had increased to 232, the number of spindles to 1,100,132, or 94 per cent in five years, and the

number of bales consumed to 315,842, or 68 per cent in five years. By 1890 the number of mills had increased to 240, the number of spindles to 1,554,000, or 41 per cent in five years, and the number of bales consumed to 526,856, or 67 per cent in five years.

Every year since 1890 there has been an increase in the number of mills and spindles in operation, and with the single exception of 1893–94, an increase in the number of bales consumed.

Some years show astonishing developments. For instance, 44 new mills were put in operation in 1890–91, 48 in 1896–97, 23 in 1897–98, 55 in 1899–1900, 82 in 1900–1901, 43 in 1901–2, and 15 in 1902–3. In fourteen years the number of mills has increased from 240 to 640.

In 1890–91 the number of spindles increased 207,547 over the previous year; in 1895–96, 484,552; in 1896–97, 476,994; in 1899–1900, 1,167,186; in 1900–1901, 591,196; in 1901–2, 931,839; and in 1902–3, 577,670. In fourteen years the number of spindles increased from 1,554,000 to 7,100,292, or nearly 357 per cent.

The largest yearly increases in the number of bales of cotton consumed are the following amounts for the years named: In 1890–91, 79,060; 1894–95, 130,023; 1897–98, 295,683; 1899–1900, 156,918; and 1901–2, 304,346. In fourteen years the consumption increased from 526,856 to 1,925,954 bales, or about 265 per cent; while the total crop taken for domestic consumption in the cotton States has increased from 7.1 to 18.1 per cent.

Consumption and production of cotton in the Southern States, 1850–1903.

Year.	Number of mills.	Number of spindles.	Number of bales consumed.	Number of bales produced.	Per cent of crop used.
1849–50	168	245,810	80,300	2,469,093	3.3
1859–60	166	304,551	101,688	5,387,052	1.9
1869–70	154	344,046	83,068	3,011,994	2.8
1874–75	181	481,821	145,078	3,832,991	3.8
1879–80	163	568,458	188,398	5,755,359	3.3
1884–85 *a*	232	1,100,132	315,842	5,706,165	5.5
1889–90	240	1,554,000	526,856	7,472,511	7.1
1890–91	284	1,761,547	605,916	8,652,597	7.0
1891–92	293	1,938,524	681,471	9,035,379	7.5
1892–93	315	2,088,697	733,701	6,700,365	11.0
1893–94	322	2,171,342	723,329	7,549,817	9.6
1894–95	323	2,382,781	853,352	9,901,251	8.6
1895–96	354	2,867,333	857,835	7,161,094	12.0
1896–97	402	3,344,327	981,991	8,532,705	11.5
1897–98	425	3,574,754	1,277,674	10,897,857	11.7
1898–99	444	3,832,401	1,413,894	11,189,205	12.6
1899–1900	499	4,999,587	1,570,812	9,112,838	17.2
1900–1901	581	5,590,783	1,576,786	10,401,453	15.2
1901–2	624	6,522,622	1,881,132	10,663,221	17.6
1902–3	640	7,100,292	1,925,954	10,630,945	18.1

a The numbers for spindles and mills are for the year 1886.

THE NATION'S FARM SURPLUS.

By George K. Holmes,
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PROPORTIONS AND MOVEMENT OF FARM PRODUCTS TO PORTS.

As well try to comprehend the distances of the stars or the duration of eternity as attempt to make intelligible the vast quantities and value of the farm products of this country, or even of the exported surplus, which is so large as to be without parallel among the countries of the earth.

A conservative estimate of the farm value of the farm products of this country not fed to live stock in 1903, on the basis of the census valuation, places it at about 4½ billions of dollars. In varying fractions parts of many of these products, not being wanted for National consumption, are conveyed to foreign countries, but are stopped at the ports and international boundaries of this country, where officers of the customs take account of them and make a record of their values and the measure and weight of such of them as are measured and weighed in commercial practice.

The values so ascertained and recorded are not farm values, since to the original farm value of the products have been added numerous charges and profits which the products must bear in the course of a distribution that is often intricate in its business details.

The export value of the exported farm products of this country was $878,479,451 in the fiscal year 1903. During the preceding five years, 1898–1902, the annual average value was $861,037,815, and during the next preceding five years, 1893–1897, it was $616,074,947. During the last eleven years the highest value reached was $951,628,331 in 1901, due chiefly to cotton.

INCREASE OF VALUE OF PRODUCTS FROM FARM TO PORT.

Within these large numbers are included elements of value after the products have left the farmers' hands. The rule of the Treasury Department is to adopt as the value of these exports their value at the time and place of exportation. Taking a view of exported farm products in general, it is perceived that among the numerous additions to the value of these products after leaving the farm are the profit of the buyer from the farmer at the local shipping place; transportation

charges to some trade center or primary market; and wharf charges, as on the Great Lakes. At the primary market also there may be elevator charges, inspection fees, storage charges, perhaps including refrigeration. Then there is the profit or commission of the dealer at the trade center, which is itself composed of numerous elements of cost, and is by no means all pure profit.

From the trade center the goods may go by rail, canal, or steamboat, or by a combination of these means, to the port, with consequent charges for transportation, while at the seaport there may be storage, perhaps including refrigeration, and the profits or commissions of wholesale dealer and exporter, which profits, as in the case of the first buyer, contain various elements of cost as well as pure profit.

So it appears that by the time the farmers' products have reached the port they are considerably more valuable than when they left his hands; but just how much more so, all products being considered, or even one product, no one has been able to ascertain. While it is possible to follow 4½ bushels of wheat from the farm to the Minneapolis mill and then follow to the port the barrel of flour made therefrom, this is practically impossible for all wheat and all flour. The problem has presented itself to statisticians and is regarded as unsolvable.

RIVALRY OF PORTS.

Nearly all of the exported products leave this country in steamships, many of which belong to lines having regular sailings, while many are "tramps," sailing hither and yon according to the best opportunity of the moment.

Various facts determine through what ports the products shall find exit. Geographical considerations are not always paramount, and, owing to low freight rates or other inducements, railroads may convey more goods to the port of farther distance than to the nearer port on the same coast. The general fact is that the North Atlantic ports have predominated over those which may be regarded as geographically competitive on the South Atlantic and Gulf coasts. Within recent years, however, New Orleans and Galveston have drawn an increasing share of the exports of grain and cotton, on account of the immense development of these products in the Southwest, and an increase in the southern movement of grain from some of the North Central States.

That geographical position may be of secondary importance to a port in the export movement is illustrated by Boston, which exports vastly more corn than Norfolk or Newport News, although considerably farther from the surplus corn States than those ports are. So, in recent years, Boston has exceeded Philadelphia in the export of wheat.

The contest among the principal Atlantic and Gulf ports for a large share of the export business in farm products has shifted with varying

success; the subject is a complicated one and requires an examination of the rates, facilities, and business of land and water transportation in the United States, terminal facilities at ports, and various accessory influences, each of which would require a long discussion by itself.

EXPORT VALUE MOSTLY IN FEW PRODUCTS.

As large as the value of our exported farm products is, it is after all mostly composed of the values of a few principal ones. The relative standing of the various principal classes of exported articles was not greatly disturbed by unusual conditions for the fiscal year 1903, when the total value of exported farm products was $878,479,451. To this sum cotton contributed $317,065,271, or 36.1 per cent, and grain and grain products $221,495,086, or 25.2 per cent, so that these two classes of farm products together constituted 61.3 per cent of the exports.

Third in the order of importance is the class of meat and meat products, with an export value of $178,456,536, and to this class may be added live animals, $34,781,193; these two classes together constituted 24.3 per cent of the value of exports of farm products.

Hence, it appears that the surplus cotton of this country, the grain and grain products, the meat and meat products, and the live animals equaled 85.6 per cent of the exports of farm products in 1903.

If to this we add tobacco, $35,250,893; oil cake and oil-cake meal, $19,839,279; fruit and nuts, $18,057,677; and vegetable oils, $16,234,362, there is no class of exported farm products left with value as high as $10,000,000 in 1903. Eight classes of products, each with an export value of more than $10,000,000, comprise 95.8 per cent of the farm exports of 1903.

IMMENSE EXPORT QUANTITIES—FOOD AND RAIMENT FOR MYRIADS.

Cotton.—Turning from values to quantities, it may be observed how incomprehensible they are. Within recent years, ending with 1903, the cotton exports have been about 3.1 to 3.9 billions of pounds, and the exported fraction of the crop has been between 62 and 72 per cent for a long series of years. In this comparison the export year is compared with the preceding crop year.

Wheat.—With a similar comparison and with the reduction of wheat flour to wheat at the rate of 4½ bushels of wheat to the barrel of flour, it appears that in the last dozen years the fraction of the wheat crop that has been exported has been about 27 to 41 per cent, and the exported wheat and wheat flour, the latter reduced to bushels of wheat, have yearly averaged somewhat more than 200 million bushels since 1897, before which period for many years the quantity was usually 50 to 100 million bushels less.

Corn.—Only a small portion of the corn or maize crop is exported as corn, the highest percentage, 11.1, being for 1898. In the following year the percentage was 9.2; it was 10.3 per cent in 1900; 8.6 per cent in 1901; only 1.8 per cent in 1902, the year when there was only two-thirds of a full crop; and 3 per cent in 1903. Notwithstanding these small percentages the exported bushels rise to 100 or 200 million.

Meats.—It is in the form of meat, however, that a large portion of the corn crop is exported. In 1903 the beef exports weighed 385,030,329 pounds, the pork exports 551,363,749 pounds, the lard exports 490,755,821 pounds, and the oleo oil exports 126,010,339 pounds.

Tobacco.—Unmanufactured tobacco, which may be regarded as the fifth or perhaps sixth export, classed in point of value, was represented in 1903 by an export of 368,184,084 pounds.

Butter and cheese.—Exports of these have decidedly declined within two or three years, with several reasons for this result. The exportation of filled cheese and oleomargarin for sale as full-cream cheese and pure butter had been carried on to such an extent that the genuine cheese and butter of this country have had a rather bad name in the foreign markets. At the same time some of our competitors have been careful not only to make high grades of cheese and butter, but to suppress counterfeits, and Canada is conspicuous for its recent achievements in these directions. While this competition in excellence had been to our disadvantage in foreign markets, through its freedom from any taint of deception, a recent competition has sprung up in the large quantities of butter exported from Siberia. Much of this butter goes to Denmark, as in the case of Swedish butter, in order that it may be exported from that country, which has an enviable reputation in the world's markets, and the result is that within a year or so there has been an abundance of butter production in surplus countries, sufficient to depress the price close to the margin of export profit for this country. Another cause of the decline of our butter and cheese exports is the growing consumption in this country, which perhaps has been advancing faster than the production.

Within very recent years exports of butter have been confined to inferior grades. The London prices of superior butter have often been lower than the New York prices; there has been no surplus of this butter for export, and but little of the lower grades.

Fruits.—Among the exports of minor importance in point of value are fruits, yet they attract much attention at home on account of the expansiveness of their markets, and abroad on account of their superior excellence. The exports of fresh apples had grown to 1,656,129 barrels in 1903; of dried apples, to 39,646,297 pounds; of dried

apricots, 9,190,081 pounds; of prunes, 66,385,215 pounds; and of raisins, 4,280,028 pounds.

A main reason why the exports of fruits are not greater is the enormous consumption by 80 millions of people at home and a production so far increasing barely fast enough to sustain the increased consumption. Fruit consumption in this country undoubtedly increases much faster than population. Indeed, there seems to be no limit to the market for fruit of first quality.

Within a few years the results of an enormous extension of orchard planting will begin to appear, and some of these results may be found in a much increased surplus for export. There is room for much improvement in packing in a great portion of the fresh apple exports, most of which go in barrels. There are still too many men who pack the barrels and do not know that they are deceiving themselves more than their customers by putting inferior apples away from the ends of the barrels in the packing. Canada again, as in the case of cheese and butter, has established and secured honesty in fruit packing for export, much to her advantage.

Other relatively minor classes, and yet having large quantities of export, are glucose and grape sugar, with 126,239,981 pounds; cotton seed, 51,622,370 pounds; clover and timothy seed, 33,812,444 pounds.

Notwithstanding the enormous production of eggs, this country has so far been able to export what is comparatively an insignificant number of dozens. The undoubted reason for this, as partly in the case of fruits, is the generous National consumption, which is far outrunning the growth of population.

There is little export of wool; the home production is inadequate to the demands of manufacture, so that vast quantities are imported. A surplus of the hop crop remains for export yearly, notwithstanding the demands of the brewing industry in this country. In 1903 the exported hops weighed 7,794,705 pounds. The starch exports have observable proportions, the quantity in 1903 being 27,759,599 pounds.

Animal matter relatively losing ground.—The exports of farm products are fundamentally classified as animal matter and vegetable matter, not including forest products. The relative proportions of these two classes of exports during the last dozen years have changed with some irregularity, but on the whole the exports of animal matter are losing ground relatively with a corresponding gain by vegetable matter.

DESTINATION OF THE SURPLUS.

The next inquiry is, Where do our exports of farm products go? It will be remembered that by far the principal portion of these exports was included in the four classes of cotton, grain and grain products, meat and meat products, and live animals; so in the case of destination

of exports there is a concentration, although in a less degree. The United Kingdom takes about one-half of the exports of the farm products of this country, and Germany about one-sixth, while France, the Netherlands, Belgium, Canada, and Italy take from 3 to 5 per cent each. Farm products go from this country to many strange and remote nooks and corners of the world. Africa, interior and coastwise, gets them in considerable amounts. Over 2 per cent of these exports in 1902 went to British Africa. Portuguese Africa takes as much as one-fourth of 1 per cent of our total farm product exports. China in recent years takes a million dollars' worth of them annually. These exports go to Russian China, to lone islands in the Atlantic and Pacific Oceans, to Korea, to the icy shores of Greenland and Iceland, and to all of the many nations of the American Continent, of Europe and Asia, and to the various governments of Australasia.

Upon dividing the countries of the earth into six natural geographical sections, it is noticed that the exports of farm products to Europe amount to about 85 to 90 per cent of the total; North America, 6 to 7 per cent; and Asia, South America, Africa, and Oceania less than 3 per cent each.

CONSPICUOUS CLASSES.

The principal and conspicuous classes of exports may be traced instructively to their destinations. In recent years about 45 per cent in value of the exported part of the cotton crop has gone to the United Kingdom; about 24 per cent to Germany; about 11 per cent to France; 5 to 7 per cent to Italy; from 3 to 4 per cent to Spain; from 1 to 5 per cent to Japan; 1 to 2 per cent each to Belgium, Canada, and European Russia. The percentage of the value of exported cotton going to every other country is less than 1 per cent each, and among these countries of less consequence in this matter, yet receiving from this country cotton valued at $1,000,000 to $3,000,000, are Mexico, Austria-Hungary, the Netherlands, and Denmark.

Again, in exported grain and grain products the United Kingdom is by far the principal customer, since about one-half of these exports go to that country. Germany stands second as a customer, and takes a full 10 per cent of these exports, while the Netherlands stands third and somewhat under 10 per cent; Belgium is fourth in order with 5 to 6 per cent; and Canada fifth with 4 to 5 per cent.

Grain and grain products are much more widely distributed from this country throughout the world than cotton. Wheat being the principal grain exported, the percentages representing its distribution in the principal countries are nearly the same as those given above for all grains and their products.

Of the exported meat and meat products, the United Kingdom takes about 62 per cent, Germany about 12 per cent, the Netherlands

about 7 per cent, and Belgium 3 to 4 per cent; 1 to 2 per cent of the exports go severally to Cuba, Sweden and Norway, Denmark, Canada, British Africa, France, British West Indies, and Brazil.

The live-animal export is mostly to the United Kingdom. It consists almost entirely of beef cattle, and that country takes two-thirds to 85 per cent of them. For a few recent years British South Africa took most of the exported horses and mules.

Geographical concentration of destination also marks the distribution of tobacco exports. One-third of these are to the United Kingdom; Germany gets one-seventh to one-sixth; Italy one-eighth to one-seventh; France one-tenth; and Belgium, the Netherlands, Canada, Japan, Spain, British Australasia, and British Africa from 1 to 6 per cent each.

Oil cake and oil-cake meal go principally to the United Kingdom, Germany, the Netherlands, Belgium, and Denmark in varying proportions, and the vegetable oils go principally to the Netherlands, France, Germany, United Kingdom, and Belgium. The United Kingdom gets two-thirds of the exported butter and nine-tenths of the cheese. The hop market is almost entirely in the United Kingdom, and the foreign vegetable market is chiefly in Cuba, Canada, United Kingdom, and Mexico.

About seven-eighths of all exported fresh apples go to the United Kingdom, while Germany takes 5 to 10 per cent. Germany gets nearly one-half the dried apples; the Netherlands one-fifth to one-third; Belgium and the United Kingdom a tenth each. The prunes are bought mostly by Germany, the Netherlands, United Kingdom, Canada, Belgium, and France, and the foreign market for raisins is in Canada to the extent of two-thirds of the export. The remainder goes chiefly to British Australasia and Mexico.

COMPETITORS IN TWO CHIEF IMPORTING COUNTRIES.

Having observed that by far the principal portion of the value of exports of farm products is concentrated upon a few classes of them, and that about one-half of the exports are sent to the United Kingdom, and about two-thirds to that country and to Germany, it will be instructive to turn to the imports of farm products into those countries for the purpose of ascertaining who the competitors of this country are in those markets, and to point out relative standings.

COMPETITORS IN THE UNITED KINGDOM.

During the calendar year 1900 the imports of farm products into the United Kingdom were valued at $1,577,522,533, an amount not greatly different from the average of recent years. The contribution to these imports from the United States was 32.5 per cent, so that

about one-half of the exports of the farm products of the United States become about one-third of the imports of farm products into the United Kingdom.

For the year mentioned France was next in importance to the United States among foreign nations as a contributor to the agricultural imports of the United Kingdom, although far below, its percentage being only 6.5; next in order was Germany, 5 per cent; the Netherlands, 4.4 per cent; Argentina and Russia, 4 per cent each; Denmark, 3.9 per cent; Egypt, 3.8 per cent; Belgium, 2.2 per cent; Spain, 1.7 per cent; and Asiatic Turkey, 1 per cent. All other foreign countries contributed less than 1 per cent each.

The British colonies contributed in the aggregate 24.3 per cent, subdivided as follows: Australasia, 9.2 per cent; British East Indies, 8 per cent; Canada, 4.4 per cent; all other British possessions, 2.7 per cent.

Meat, meat products, and animals.—The United States has a long lead over its competitors as a purveyor of meat, meat products, and animals to the United Kingdom. The cattle imports for 1900 were valued at $43,857,842, of which the United States supplied 72.1 per cent; Canada, 20 per cent; Argentina, 7.4 per cent. The imported fresh beef was valued at $39,724,500, of which 74.2 per cent came from the United States; 14.3 per cent from Australasia; 8.2 per cent from Argentina. The United States also supplies the principal portion of the imports of salted or pickled beef, cured beef not more specifically indicated, bacon, hams, salted or pickled pork, lard, oleo oil, and cured meats not more definitely described.

Dairy products.—As a contributor of dairy products the United States is far behind its competitors. The butter imports of 1900 were valued at $84,922,542, but the United States contributed only 1.4 per cent, thus standing in the rear of Denmark with 46 per cent; France, 10.2 per cent; the Netherlands, 8.1 per cent; Sweden, 5.8 per cent; Russia, 5.6 per cent; and Belgium, 2.1 per cent; and also in the rear of Australasia with 14.4 per cent, and Canada with 3.7 per cent. A better showing is made by the United States in the imports of cheese into the United Kingdom, which were valued at $33,276,558 in 1900. Canada contributed 55.6 per cent; United States, 25.5 per cent; the Netherlands, 11.7 per cent; Australasia, 3.2 per cent.

Eggs.—Eggs are imported into the United Kingdom in large quantities, their value for 1900 being $26,308,396. These come principally from Russia, Germany, Denmark, France, and Belgium in fractions varying from one-eighth to one-fifth of the total. Canada sends 5.3 per cent, and the United States only 2.9 per cent.

Cereals.—In the great totals of imports of cereals into the United Kingdom the United States stands preeminently conspicuous, as in

the case of meat and meat products. That country received from abroad wheat to the value of $113,612,963 in 1900, and about one-half of this came from the United States, one-quarter from Argentina, 9.5 per cent from Canada, 6.5 per cent from Russia, and 5.6 per cent from Australasia. The imported wheat flour was valued at about two-fifths of the wheat imports, and more than four-fifths of this flour came from the United States, while Austria-Hungary supplied 6.2 per cent; Canada, 5.7 per cent; France, 3.2 per cent; and less than 1 per cent came from Argentina and Russia together.

Naturally also the chief portion of the imports of maize is from the United States, the fraction being 69.7 per cent of $59,993,526. Argentina sent 12.3 per cent; Canada, 8.7 per cent; Roumania, 4.9 per cent; Russia, 3.9 per cent.

In barley imports the United States, Russia, and Asiatic Turkey each supply about one-quarter, and about one-third of the rye imports are contributed by Russia and nearly the same fraction by the United States. In oats, however, Russia is far in the lead, with more than one-half of the contribution to total imports valued at $25,482,984, while the United States sends a little over one-quarter, and Germany less than one-tenth. Nearly all of the imported maize meal and oatmeal and groats comes from the United States.

COTTON.—The greatest of all the United Kingdom agricultural imports is raw cotton, the value of which in 1900 was $199,441,794. The cotton supplies of the United States found practically no competitor in the same grades of cotton in the British market, the supply from this source being 73.7 per cent of the total. The Egyptian supply was 22.1 per cent; that from the British East Indies, 1.7 per cent; and from Brazil, 1.6 per cent.

FRUITS.—This country has a strong hold upon the British market in the supply of some fruits and a weak one in others. Nearly one-half of the imported fresh apples came from this country in 1900; one-third from Canada; one-tenth from Australasia. The imported fresh apricots and peaches are of small value, and the United States supplies only one-tenth; most of the imports come from France. Fresh pears are more important, and were valued at $1,785,324 in 1900, of which over one-tenth came from this country; France supplied about two-thirds, and Belgium nearly one-fifth. More than one-half of the imported prunes came from France and about one-third from the United States.

OTHER PRODUCTS.—A considerable quantity of hay comes from the United States to Great Britain, the value being somewhat less than $1,000,000 in 1900, or 42.5 per cent of the total imports; one-quarter of the imports were from the Netherlands, one-eighth from Canada, and over one-tenth from France.

The principal portion of the hop imports comes from the United

States—73.6 per cent in 1900, Belgium being in second place, with 17 per cent. Nearly three-fourths of the cotton-seed oil cake is derived from the United States, and the principal competitor is Egypt, with nearly one-fifth; but in the case of flaxseed oil cake the United States contributes only one-quarter, while Russia and Germany supply about one-third each. A large amount of cotton seed is imported which comes almost entirely from Egypt. The imported flaxseed is mostly obtained in the British East Indies, Russia, and Argentina.

The tobacco supply of the United Kingdom was valued at $14,281,031 in 1900, and 84.4 per cent of this was obtained in the United States; 9.2 per cent from the Dutch East Indies.

COMPETITORS IN GERMANY.

Germany has hardly one-third of the importance of the United Kingdom as a recipient of exports of farm products from this country, yet the total imports of farm products into that country in the calendar year 1901 were valued at $790,564,700. The United States contributed $172,837,600, or 21.9 per cent, this fraction being larger than that of any other country. Russia stands second, with 16.3 per cent; Austria-Hungary third, with 10.6 per cent; then follow the British East Indies, with 5.6 per cent; Argentina, 5.4 per cent; Italy and France, 4.4 per cent each; the Netherlands, 4 per cent.

PLACE OCCUPIED BY THE UNITED STATES.—Farm products constitute a much larger percentage of the imports of the German Empire than they do in this country, the percentage for Germany being 59.2 for the five years 1897–1901. Of imports of agricultural raw materials, the United States supplied 20.5 per cent in 1901; food products, 21.7 per cent; feed stuffs, 37.3 per cent; miscellaneous farm products, 3 per cent.

With a more specific classification of imported farm products the position of the United States as a contributor may be better understood. This country sent to Germany 57 per cent of the value of its imports of meat and meat products in 1901; 55.7 per cent of the vegetable fibers (almost entirely cotton); 35.3 per cent of the grain and grain products; 8.2 per cent of the tobacco; 6.1 per cent of the fruit and nuts; 5.7 per cent of the seeds; 2.3 per cent of the hides and skins; one-fourth of 1 per cent of the live animals; and only one-tenth of 1 per cent of the animal fibers.

ANIMAL PRODUCTS.—Such small quantities of butter and cheese find their way from the United States to the German markets that the former country can hardly be looked upon as having any footing in German markets in the sale of these products. Only three-quarters of 1 per cent of the total imports of dairy products come from the United States. Very little fresh meat of any kind comes from this

country, but the United States supplied 85 per cent of the cured beef in 1901; 85.1 per cent of the bacon; 46.2 per cent of the hams; 59.5 per cent of the salted or pickled pork; 97.6 per cent of the lard; 98.2 per cent of the lard compounds; 93.8 per cent of the oleo oil; 26.2 per cent of the sausage casings; 63.8 per cent of the stearin; and 47.7 per cent of the tallow. The principal competitors of this country in these classes of German imports are Denmark, the Netherlands, Austria-Hungary, and, in sausage casings, Russia; in tallow, the United Kingdom and British Australasia.

FRUITS.—In 1901 the apple imports of Germany were nearly one-half derived from Austria-Hungary; about one-fifth from France; one-eighth from Italy; one-eighth from Belgium; and only 2.4 per cent from the United States. Almost no other fresh fruits were received from the United States; but a large quantity of dried fruits ("not elsewhere specified"), including dried apples and prunes, was received from the United States, their value being $2,078,100, or 43.4 per cent of the total imports of this class. The chief competitors were Austria-Hungary and Servia, each contributing one-fifth, and France, one-tenth.

CEREALS.—Germany's imports of wheat in 1901 were valued at $67,283,100, of which 58.4 per cent came from the United States; a little over one-fifth from Russia; one-tenth from Argentina—but the United States was exceeded in the supply of wheat flour by Austria-Hungary, which contributed 58.8 per cent as against 28.7 per cent by the United States. About one-half of the barley imported into Germany comes from Russia, and two-fifths from Austria-Hungary. The United States makes a bare showing. One-fourth of the imported buckwheat is from the United States and more than one-half from Russia.

As might be expected, the United States contributes the principal portion of the supply of imported maize (about two-thirds); Argentina sends about one-eighth, Roumania about one-tenth, and Russia about one-twentieth. Russia sends about seven-eighths of the oats and the United States about one-tenth; Russia about nine-tenths of the rye and the United States one-twentieth.

Almost the entire imported malt comes from Austria-Hungary; the bran is supplied by Russia, Austria-Hungary, Argentina, and the Netherlands, in order of importance, with the United States contributing only 3.2 per cent.

OTHER PRODUCTS.—The oil cake and oil-cake meal received from the United States by Germany in 1901 were two-fifths of the total imported; from Russia, one-fourth; from France, one-twelfth. The imported flaxseed comes mostly from Argentina, the British East Indies, and Russia, leaving only one-tenth of the imports to the United

States. Two-thirds of the imported leaf tobacco comes directly or indirectly from the Dutch East Indies, about one-eighth from Brazil, and one-twelfth from the United States.

SUMMARY.

From totals of incomprehensible magnitude and from a bewildering mass of details concerning the exports of farm products from this country, classification and comparison reduce the subject to what are, after all, rather simple terms when separated from numerical aggregates.

The vast total of exports is composed mostly of cotton, grain and grain products, and meat and meat products, with places of much less although of large importance taken by tobacco, live animals, oil cake and oil-cake meal, fruits and nuts, and vegetable oils. With attention concentrated upon three or four, or at most upon all these eight classes of products as exports to the countries of the earth, it may be still further concentrated upon the United Kingdom as receiving one-half of all this country's exports of farm products, and, in a less degree, upon Germany, the recipient of one-sixth, all other countries being individually of minor importance in the general survey.

So it becomes easy to find our principal competitors, which are, in meats and meat products, Australasia, Argentina, and Canada, and Denmark in bacon; in live animals, Argentina and Canada; in grain and grain products, Argentina, Russia, Canada, and Roumania, and at times British India and Australasia; in tobacco, the Dutch East Indies; while in cotton the other countries of the earth have not yet produced a direct competitor of the upland varieties grown in this country.

RELATIONS OF FEDERAL GOVERNMENT TO CONTROL OF CONTAGIOUS DISEASES OF ANIMALS.

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Chief of the Bureau of Animal Industry.

INTRODUCTION.

The breeding, raising, and feeding of farm animals, and the gathering and preparation of animal products, constituting what is known as the animal industry, is, under ordinary circumstances, probably the most profitable branch of agriculture, and seems to be essential to successful farming. Its importance is recognized by everyone, as it is hard to imagine a permanently prosperous country where the conditions are such that animal production is impracticable. Most enlightened governments have, therefore, fostered and encouraged the animal industry, and have endeavored to throw around it such safeguards as could be suggested to protect it from the numerous destructive diseases or animal plagues which from time immemorial have constantly existed in some part of the world, always ready to follow the lines of traffic and overrun fresh territory.

The contagious diseases of animals have been known through all historic time, and probably existed many centuries before the art of writing was discovered; but their ravages were held in check by the very conditions which they themselves created. The more animals they destroyed, the fewer there were left to prey upon; and as the animals decreased in numbers they were more scattered and less liable to come in contact with each other. Consequently, the chances of contagion were diminished and the diseases gradually subsided, until with the increase of animal life the conditions again became favorable for infection. With the increase of human population and the development of agriculture we are constantly endeavoring to multiply our stock of farm animals, and in doing so we make the conditions more and more favorable for the spread of disease. It is true that by confining animals to certain farms or pastures they are prevented from spreading infection to the same extent as when they roam unrestricted in nature; but this influence for good is offset by the traffic in animals between farm and farm, by the driving and shipment of animals to distant markets, and by the importation of animals from all parts of the world.

DISEASES IN THE UNITED STATES AND CONTROL OF CONTAGION.

In the United States we have an enormous aggregation of animals; great activity in the traffic and transportation of animals between different sections of the country; a large importation from other parts of the world; and, in short, all the conditions which favor the spread of disease, if the contagion is allowed to establish itself within our territory. Fortunately, the Federal Government began the supervision of imported animals before many Old World plagues had been introduced upon this continent, and as there were few indigenous diseases of a rapidly spreading character, our farm animals have not been destroyed by disease as they have been in many other parts of the world. Nevertheless, certain contagious diseases exist here and are very troublesome and destructive. Among these may be mentioned glanders, cattle and sheep scab, Texas fever, tuberculosis, and hog cholera and other infectious diseases of swine. Pleuro-pneumonia and foot-and-mouth disease have invaded our territory several times in the past, but have been entirely eradicated by the Federal Government.

DISEASES EXISTING IN FOREIGN COUNTRIES.

In most other countries of the world there exist extremely fatal diseases of animals, which are difficult to control, and which are not known in the United States. In Europe there is foot-and-mouth disease, pleuro-pneumonia, and sheep pox; in Asia, Africa, and the Philippines there is rinderpest and surra; in Australia and South Africa there is pleuro-pneumonia; in South Africa there are also a number of very fatal diseases, such as horse sickness, coast fever, and heart water, which are as yet imperfectly understood; in South America foot-and-mouth disease has spread beyond control, and threatens us through animal products, such as wool, hair, and hides, and also by advancing overland to our Mexican frontier.

NECESSITY OF CONTROL OF CONTAGION BY FEDERAL GOVERNMENT.

It is plain from experience in the past that neither the farmers of the country nor the individual States can protect themselves either from the diseases which have become indigenous to the country or from those which exist in other lands. To prevent the spread of these forms of contagion there must be expert inspection of animals that are to be shipped in the general commerce of the country, and this inspection should be made as near as possible to the point of origin; stock yards and stock cars must be kept free from infection; suspected animals must be kept in quarantine until they are safe; diseased animals discovered in transit must be disposed of in such manner as to reduce to a minimum the danger of spreading disease. In order to carry on

such a service successfully the office conducting it must have complete information as to the existence of contagious diseases in the various States of the Union, and also in the different countries of the world. This information can only be obtained by the Federal Government, which has its agents in all countries from whom regular and reliable reports are received. Again, the supervision, inspection, and quarantine of imported animals and the regulation of interstate shipments so as to exclude contagion can only be performed by the Federal Government, and attempts to exercise this power by the States have been and must necessarily be imperfect and of little avail. The stamping out of diseases as they exist on farms and ranches would seem to come under the police power of the individual States, but when a disease has spread to any considerable extent experience has shown that even the largest and wealthiest States are unable to accomplish this successfully without the cooperation of the General Government.

WORK OF THE BUREAU OF ANIMAL INDUSTRY.

SUCCESSFUL CONTROL OF DISEASES.

The history of the contagious pleuro-pneumonia of cattle in the United States is very instructive. This contagion remained upon our soil for more than forty years, and States like New York, New Jersey, and Pennsylvania attempted without success to stamp it out of their territory. It was the presence of this disease which led the Federal Government to establish a Bureau of Animal Industry and to confer upon it certain powers looking to the control and eradication of animal plagues. The work with pleuro-pneumonia was begun in 1884, and in a few years and with comparatively small expense the contagion was entirely eradicated. In the same manner the outbreak of foot-and-mouth disease, which occurred in New England in 1902, was completely stamped out. Since this line of executive work by the United States Government was begun, the needs of the country and the experience of the service have led to the granting of additional power and to the extension of the field of work, so that now indigenous diseases such as Texas fever, sheep scab, and cattle scab are being controlled; quarantine stations are maintained on the seaboard and inspection stations along our land boundaries; supervision has been established over stock yards and animals in transit; and, in general, a comprehensive system for repressing animal diseases has been put in operation. This being the actual condition, everyone interested in American agriculture should know the details about what the Government is trying to do, and what is expected of the citizen under the present laws and regulations.

NEED OF COOPERATION OF STOCKMEN.

It is the policy of the Department of Agriculture to move conservatively in the effort to control and suppress the contagious diseases of animals, to do its work in such a manner as to disturb as little as possible the ordinary business operations in live stock, and to protect the farmer and ranchman from unnecessary restrictions and burdens. To carry out this policy successfully, however, the Department must have the loyal and zealous cooperation of all who feed, ship, and deal in cattle; for if it is found that the leniency of the Government is taken advantage of to ship diseased animals and to spread contagion, the regulations must be made more stringent, even if by so doing temporary loss and hardship should result. It has sometimes happened in the past that regulations which, had they been observed, were amply sufficient to control the disease at which they were aimed have failed to produce the desired effect because they were constantly ignored and violated. This failure on the part of those engaged in the animal industry to observe needful regulations and to cooperate with the Department must from the nature of the case react upon that industry, because more stringent measures must be adopted, involving greater interference with business, and extending the period during which these inconvenient requirements must continue.

LAW CONTROLLING SHIPMENT OF LIVE STOCK.

The law provides that no railroad company nor the owners or masters of any vessel or boat shall receive for transportation or transport, from one State or Territory to another, or from any State into the District of Columbia, or from the District into any State, any live stock affected with any contagious, infectious, or communicable disease; nor shall any person, company, or corporation deliver for such transportation to any railroad company, or master or owner of any boat or vessel, any live stock, knowing them to be affected with any contagious, infectious, or communicable disease; nor shall any person, company, or corporation drive on foot or transport in private conveyance from one State or Territory to another, or from any State into the District of Columbia, or from the District into any State, any live stock, knowing them to be affected with any contagious, infectious, or communicable disease. The only exception to this statute is a provision that the so-called splenetic or Texas fever shall not be considered a contagious, infectious, or communicable disease within the meaning of the law, as to cattle being transported by rail to market for slaughter, when the same are unloaded only to be fed and watered in lots on the way thereto.

VIOLATIONS OF ORIGINAL LAW AND SUPPLEMENTARY LEGISLATION.

Briefly, then, it is a violation of the law for any person, or any company, to offer for shipment, or to take in any manner, any live stock affected with a contagious disease from one State or Territory to another. This law has been constantly violated by the interstate shipment of live stock affected with glanders, sheep scab, cattle scab, tuberculosis, and other contagious diseases. The loading chutes, stock cars, and stock yards are thus kept infected, and the purpose of the law is defeated. There have been comparatively few prosecutions for such shipments of diseased stock, because the disease was not discovered until the animals reached some stock yard, generally hundreds of miles from the point of origin, and then it was impossible to prove that the shipper knew them to be diseased at the time of shipment. Doing the best that is possible by inspection at the principal stock yards, sufficient evidence to secure conviction could not be obtained against one in a hundred of the violators of the law. This fact, which has been brought out with great clearness by the experience with sheep scab, made it necessary that measures should be adopted which would fix the responsibility upon the persons who ship the diseased animals, and which would, so far as possible, prevent such shipments. By the most recent regulations, therefore, persons owning, managing, or transporting animals are required to exercise reasonable diligence to ascertain that the animals are not affected with any contagious or infectious disease, and have not been exposed to the contagion of such disease by contact with other animals so affected, or by being in or upon pens, premises, cars, or other vehicles contaminated by diseased animals, before offering them for transportation or transporting them or introducing them into public stock yards or upon public highways or lines of interstate traffic.

SPECIAL MEASURES TO PREVENT SPREAD OF CONTAGIOUS DISEASES.

In addition to the provision making it the duty of the shipper to know that his stock is free from disease before he ships it in the channels of interstate commerce, special measures applicable to each particular disease are adopted to guard against the spread of contagion by ignorant, careless, or lawless persons. In States where disease is widely disseminated live stock will be inspected before shipment is allowed, and by cooperation with the State authorities the flocks and herds which are found to be diseased upon such inspection will be quarantined until proper measures are taken to eradicate the contagion.

POWER GIVEN THE SECRETARY OF AGRICULTURE.

By act of Congress, approved February 2, 1903, authority is conferred upon the Secretary of Agriculture to make such regulations and take such measures as he may deem proper to prevent the

dissemination of the contagion of any contagious, infectious, or communicable disease of animals from a foreign country into the United States or from one State or Territory of the United States or the District of Columbia to another. And the violation of the act or of the orders or regulations made in pursuance thereof is a misdemeanor, punishable by a fine of not less than $100 nor more than $1,000, or by imprisonment not more than one year, or by both such fine and imprisonment. It will be seen, therefore, that the authority and the responsibility for the control of the contagious diseases of animals have been fully placed within the Department of Agriculture, and it is the duty of this Department to protect the agricultural interests of the country from the spread of such diseases by all the means in its power. The Department has endeavored to avoid extreme measures, and in case of doubt has given the benefit of this to the owner of diseased stock discovered in transit from one State to another; but this leniency has by some been taken as a sign of weakness and has led them to defy the regulations and the inspectors by other violations of a most glaring character. Such action can not be tolerated, and those guilty of it in the future will have only themselves to blame if the penalty of fine or imprisonment, or both, is imposed upon them.

DISEASES THE DEPARTMENT IS ENDEAVORING TO CONTROL.

The diseases which the Department is now striving most earnestly to control are sheep scab, cattle scab, and Texas fever. A brief statement in regard to each of these diseases will serve to indicate present conditions and perhaps show what may be expected in the future.

SHEEP SCAB.

The disease of sheep which is commonly called scab is an irritation of the skin leading to the formation of crusts or scabs, and is caused by a parasitic mite or acarus, which although very small is nevertheless visible to the unaided eye. This disease is similar to the mange of other animals, and the parasite which causes the trouble does not live in nature for any considerable time, except upon animals of this species. The disease, consequently, arises only by contagion from affected sheep, or by similar contamination from pastures, pens, sheds, cars, or other objects which have been recently infected by diseased sheep. When all the mites are destroyed, the disease will disappear and will not be seen again until more affected sheep are introduced from some other part of the world where the disease exists, that is, the disease is caused by contagion, and by contagion only. The parasites which produce it can only multiply upon the bodies of sheep, and although these parasites may live in buildings or pastures for a few weeks, or possibly, under

very favorable conditions, for two or three months, their existence in such locations is limited. Another encouraging fact is that the parasite is easily destroyed, and a number of remedies have been thoroughly tested which, when suitably applied to affected sheep, will kill the mites without injuring the animals.

Sheep scab is a far more serious disease than anyone would suppose from a casual inspection of affected animals, especially during the milder seasons of the year. In winter the symptoms are aggravated. The strength of the animal and its power of resisting adverse conditions are diminished. If the cold is extreme and the food scarce, a large part of the flock may perish, and those which survive will come through the winter in a miserable condition, which gives little prospect of profit to the owner. Under the best conditions of food and climate there is still heavy loss on account of the tearing out of the wool through the efforts of the animals to relieve the terrible itching by constantly biting and rubbing themselves. Moreover, the wool which is produced on such diseased sheep is weakened in fiber and of less value than the wool of healthy animals. There can be no doubt that this disease is the greatest obstacle to the success and prosperity of the sheep industry in the United States.

There is another side to the baleful influence of scab which should not be overlooked. Diseased sheep have been shipped everywhere; the stock yards of the country and the stock cars have been kept constantly infected; it has been next to impossible to buy sheep in the great markets for feeding or grazing without finding after they had reached the farm that they had contracted the infection; it has also been difficult to obtain pure-bred animals for improving the flocks without their becoming infected during transportation; and equally serious has been the difficulty of excluding diseased sheep from the export trade and preserving the reputation of our animals in foreign markets. These conditions are not only discouraging and intolerable to the individual sheep raiser, but they are a disgrace to any civilized country which allows them to continue. The dictates of humanity no less than the interests of agriculture require that the suffering of the animals from this cause should be abated. There is no practical difficulty in the cure and eradication of the disease if the owners will only cooperate with the authorities to that end; and if this cooperation can not be obtained spontaneously it should be stimulated by the power of the law. The individual flock owners have been unable to protect themselves, the efforts of the State governments have produced improvement only in restricted areas, and it is solely by cooperation between the Federal Government and the States that complete success is to be expected.

GOVERNMENT AUTHORITY IN CONTROL OF DISEASE.

The Federal Government takes up the work of controlling animal diseases through the power and duty which has been conferred upon it to regulate commerce between the States and with foreign countries. There has been much controversy in the past as to the extent to which the Federal Government can act in such cases, but experience has shown that practically it can do all that is necessary to accomplish the object. There would be no question raised as to the power of the General Government to inspect and quarantine, or even to exclude animals from foreign countries where contagious diseases exist; and the power over interstate commerce is just the same and was granted in the same words as the power over foreign commerce. The General Government can, therefore, without doubt, inspect and quarantine animals coming from States where such dangerous diseases exist, and if this is insufficient it can prohibit the shipment to other States of the classes of animals which are affected with the disease to be guarded against. It is evident, however, that the Federal Government should, only as a last resort, prohibit any class of interstate commerce, since it is the duty of the Government to foster and encourage such commerce and to protect instead of injuring it. For this reason it is the policy of the Government to proceed so long as possible by less drastic measures, even though these require more time, and, before resorting to prohibition and destruction of trade, to offer cooperation with men and money for the eradication of the disease. It is never the desire of this Department to trample upon local rights nor to override State authority, but where a dangerous and destructive disease is allowed to establish itself in any State and to spread until it menaces the industries of other States, an emergency has arisen which calls for effectual action, and either the State must permit the General Government to operate within its territory for the control and eradication of the disease, or it must expect to see a prohibition put upon the interstate traffic of the animals which are liable to carry the infection.

GOVERNMENT EFFORTS AGAINST DISEASE.

The history of the Department's action with reference to sheep scab shows that regulations prohibiting the shipment of diseased sheep from one State to another, and their entrance into stock yards used for the interstate trade, also requiring the disinfection of yards in which diseased sheep had been placed, were insufficient to stop the interstate shipment of such diseased animals, notwithstanding the fact that inspectors were required to make inquiries for evidence that would justify prosecution of the shippers. The first order concerning sheep scab which contained the above-mentioned requirements was dated December 13, 1895; and this was followed by the order of June 18, 1897, requiring that cars, boats, and other vehicles which have been

used for the transportation of affected sheep shall be immediately cleaned and disinfected.

At this time the number of inspectors employed by the Bureau of Animal Industry was so limited that the inspections could only be made at the principal stock yards, and it was found that diseased sheep continued to arrive in large numbers and that the regulations were without any material effect upon the traffic. The Department hesitated to issue more stringent and comprehensive orders, because it could not enforce them without a great increase of the inspection service and the expenditure of more money than was available. Such orders would also lead to serious inconveniences and burdens to traffic and to the sheep industry, and were not to be undertaken until it was demonstrated that milder measures could not be made to accomplish the object. Accordingly, it was deemed best to issue a bulletin giving full information concerning the nature of the disease, the treatment by which it could be eradicated, and the laws and regulations prohibiting the interstate shipment of affected sheep. The distribution of this bulletin gave flock owners an opportunity to inform themselves on the subject and allowed them all the time needed to rid their flocks of the disease before more drastic measures were adopted.

DIPPING SHEEP.

An important order was issued July 20, 1899, with reference to the manner in which sheep should be dipped before being permitted to go forward in the channels of interstate commerce. Previous to this time, when diseased sheep were found in the stock yards it was required that they should be dipped in some preparation for the cure of the malady before shipment to other States, but it was not specified what dip should be used nor the manner in which the operation should be conducted. The result of leaving these details to the discretion of the owners, the commission merchants, or the stock-yards companies, as the case might be, was extremely unsatisfactory; but, as these parties claimed that they had the right to treat the animals belonging to them or in their custody according to their own ideas, and as they strongly objected to dictation on the part of the Government, the dipping was left in their hands until this method of proceeding proved to be a failure. Many sheep were injured by being dipped in liquids of a scalding temperature or which were too concentrated; in other cases inefficient mixtures were used because of their cheapness, and, in general, the dipping was conducted not with the idea of curing the sheep, but to comply in the easiest manner possible with the regulations.

WHAT DIPS MAY BE USED.

The order mentioned provides that no sheep affected with scabies, and no sheep which have been in contact with others so affected, shall

be allowed shipment from one State or Territory into another, or from any State into the District of Columbia, or from the District into any State, unless said sheep shall have first been dipped in a mixture approved by this Department. A tobacco-and-sulphur and a lime-and-sulphur dip were approved by this order and the formulas given for their preparation. The owner of the animals is privileged to choose which one of these dips shall be used, but one or the other must be selected if the sheep are to be shipped in interstate commerce.

OBJECTIONS URGED AGAINST DIPPING.

At the time the order of July 20, 1899, was issued the Bureau of Animal Industry was severely criticised and its work ridiculed by interested parties, principally by the manufacturers of proprietary dips. It was said that a single dipping was useless, that sheep could not be cured by one dipping, and that consequently all the expense, inconvenience, and delay caused by this requirement went for nothing. The fact is that this dipping is a complete protection of the channels of interstate commerce so far as these particular shipments are concerned. Either of the recognized dips will kill all the mites upon the sheep at the time of dipping, and will destroy any others that get upon the animals from infected pens or which hatch from eggs upon the skin before the fleece is entirely dry, and probably for several days afterwards. The affected sheep can not be dangerous, therefore, to other animals, nor can they infect cars or railroad pens during the first week after dipping. Considered as a measure for the protection of interstate commerce, which is the paramount object of the intervention of the Federal Government, the dipping of diseased and exposed sheep would be fully justified if it did not permanently cure a single animal. The owners of the sheep or the local authorities might easily dip the animals a second time after they arrive at their destination, and thus complete the cure. Experience has shown, however, that more than 90 per cent of the animals dipped under official supervision remain free from the disease. During the year 1902 the affected sheep thus treated numbered 218,110, from which returns were afterwards received, and of this number 84.8 per cent were permanently cured. The exposed sheep dipped and from which reports were afterwards received reached the number of 572,659, and of these 94.7 per cent remained free from disease. The single dipping has, therefore, not only protected the channels of interstate commerce, but it has saved from infection the great majority of the farms to which these sheep were taken.

Another objection urged against the official dipping was that the lime-and-sulphur preparation greatly injured the wool and should not be recognized on that account. The answer to this objection is that the owner is privileged to select the tobacco-and-sulphur dip if he so desires, and there is no ground upon which such an objection can be

raised to this dip. The lime-and-sulphur dip was recognized because it is one of the most efficient preparations known for the cure of this disease; the materials are cheaper and more easily obtained than those for any other dip; the constituents are familiar to everyone and the dip is easily made and less dangerous to the sheep than most other dips. Careful investigation has satisfied the Department that the lime-and-sulphur dip is not as injurious to the wool as is frequently alleged. Wools from sheep dipped in this preparation have not only been examined by the officials of the Department, but they have been sent to the most expert judges of wool in the country, and no evidence of injury could be discovered; in fact, these wools could not be distinguished from other wools that had not been subjected to this treatment. The principal opposition to the recognition of the lime-and-sulphur dip has emanated from the manufacturers of commercial dips. These gentlemen evidently find that it is difficult to compete with this preparation either in efficacy or price, and therefore they object to its being indorsed by the Government. The Department has had in view, however, only the success of its work and the interests of the wool producers. It can not undertake to eradicate a disease and at the same time preserve the market for the remedies that are manufactured to cure that disease. Moreover, its first duty is to the farmers and stock raisers, and it should in its official dippings require the most effective, the cheapest, and the safest preparations attainable; and in order to conduct the work successfully the composition of the dips should be known, and it should be possible to learn by simple tests if they are made and used of standard strength.

Probably the most sincere objection that has been raised to the recognized dips is that they injure the business of the manufacturers of commercial dips. It is said that sheep raisers have obtained the impression that they must use the official dips, even upon farms and ranches, if their sheep are allowed to go into the channels of interstate trade. It has been the intention of the Department to avoid any interference with the home dipping of sheep, and therefore to permit the owner to select in the freest manner the remedy which he used. For nearly four years this policy was carried out without obtaining a satisfactory diminution of the disease on the farms and ranges where the sheep are produced. It has even been charged by the dip manufacturers that the disease increased in prevalence rather than diminished during these years. As a matter of fact, it has increased in some sections and decreased in others, the general result being a substantial gain for the better. It has been made plain, however, by the correspondence and official reports of the Department that some of the commercial dips are inefficient and unreliable; that some have proved very dangerous to the animals dipped; and that in no case that has been brought to its attention has the disease been eradicated in any State

except by official supervision of the dipping. There are only a very few States in which success has been achieved through the efforts of the local authorities; but generally the lack of funds, insufficient power, the interference of local interests, and errors in management have defeated the object for which the work was instituted.

INSPECTION OF SHEEP AT TIME OF SHIPMENT.

Beginning with 1899 the Department adopted the policy of stationing inspectors in the interior of the country to inspect sheep at the time of shipment, preventing the diseased ones from going out of the State, and granting permits to those which are healthy. This service has been gradually increased as money and men were available, and, as might be expected, the number of diseased sheep reaching the central markets of the country has been materially lessened. Unfortunately, there are many men who, instead of curing their sheep, resort to subterfuges and deception in order to get them to market. The sheep which show no signs of the disease, but which are, nevertheless, exposed, are sorted from the flock and driven to such a distance from the affected ones that the inspector can only see the former, and, knowing nothing of the latter, he is deceived into permitting the exposed sheep to go forward to market. After these infected animals are crowded together on the cars for a few days the symptoms of the disease appear, and the shipment must be stopped at the first inspection point where their condition is revealed. The shipper claims that he did not know the animals were diseased, or sometimes has the assurance to put his case forward as evidence that the inspection is worthless. Under any circumstances, cars and stock yards are infected and the diseased sheep found in transit must be disposed of in some manner that will guard against further damage. In other cases sheep are infected by being driven over ranges or through pens where diseased animals have been, and these sheep will show symptoms of the disease when they reach market, and yet their owners may be innocent of any knowledge of their exposure.

SOUND SHEEP INFECTED IN TRANSIT.

These cases of sheep which were sound at the time of shipment coming down with scabies before they reach market have been so frequent that it has become evident little more progress can be made for the control of the disease until effectual work for its suppression is done in the States where it exists. It was therefore decided to refuse permits for the shipment of sheep from certain badly infected States unless they were dipped or unless it could be shown that the county in which the shipment originated was free from infection; and it was also decided to aid the State authorities in such cases to conduct the proper measures for eradicating the disease. The diseased

sheep have been dipped until cured and until infection was no longer contracted from the pastures, and all the sheep in some of the worst infected counties were given the same treatment, whether they presented symptoms of the disease or not. The cooperation of the State and Federal authorities to enforce these measures has been successfully carried out, and although the first season's work left something to be desired in the way of thoroughness it resulted in a great decrease in the extent of the infection. If the dipping is begun again early in the spring and the ranges are protected from infection, the probability is that during the coming year good results will be much more apparent than they were last year.

OFFICIAL AND PROPRIETARY PREPARATIONS.

In these dippings under the combined authority of the State and Federal governments it has been required that the officially recognized preparations should be used. This has brought many protests from the manufacturers of proprietary dips, who claim that their business is being ruined in the States where these operations are being conducted. Undoubtedly, the statements as to loss of business under these circumstances are correct, but nevertheless it is not apparent how the Government can properly proceed and at the same time protect the manufacturers of these remedies. The stamping out of the disease must necessarily destroy the market for remedies, and during the stamping-out process remedies must be used of known composition and which are safe and reliable in their effects. Some of the proprietary dips are apparently good and others are certainly bad, but to investigate all of them thoroughly and attempt to discriminate between them would be a long and expensive undertaking and one that would probably be unsatisfactory to all parties. If such a work were successfully completed and certain preparations were recommended the composition of which is secret, there would be nothing to prevent unscrupulous dealers from depreciating the quality, relying upon the Government indorsement rather than upon the excellence of the product for their sales. Such frauds are always liable to occur, bringing loss to the consumers and suspicion upon the officials who gave the indorsement; therefore the opportunity for them should be avoided whenever it is possible to do so.

For the reasons which have been given, the work with sheep scab will continue on the same lines as have been followed in the past. There will, however, be stronger and more determined efforts to stamp out the disease at the point of origin. More stringent measures will be adopted to prevent the shipment of diseased or exposed sheep from one State to another, and an attempt will be made to hold those who violate the law and regulations to more strict accountability by bringing prosecutions whenever sufficient evidence can be obtained. The

Department relies upon the cooperation not only of the States, but of the individual flock owners, in whose behalf this work is being conducted and who will be so greatly benefited if it succeeds.

CATTLE SCAB.

The disease known as cattle scab is also caused by an acarus or mite, and this belongs to the same species as the one which produces sheep scab; but these mites, although very closely related, constitute different varieties, and the sheep mites do not cause disease in cattle nor the cattle mites in sheep. This disease has spread tremendously throughout the Western States, and especially in the range country, during the last half dozen years. In some sections practically all of the cattle are affected. In summer the symptoms are mild and attract little attention, but as cold weather comes on they are more intense. The animals lose flesh and vitality. They are unable to resist at the same time the debilitating effect of the disease and the demands made upon the system by a long and severe winter. As a result of these conditions large numbers of these animals succumb, the losses being greater in the northern than in the southern sections of the country.

EFFECT OF THE DISEASE ON CATTLE TRAFFIC.

In addition to the direct losses of cattle the obstacles to traffic and shipments are becoming very serious. People are alarmed over the continued existence of the disease, and many have stopped buying these animals. It is becoming more difficult to move affected herds in the States where they exist, while their shipment out of the State is a violation of the Federal statutes. This being the case, it is apparent that unless vigorous action is taken it will be impossible to market the cattle crop of this year from the affected sections; but to hold back so many cattle for another year's markets will be a great hardship to the producers, and it may be almost an equal hardship to the consumers.

IMPORTANCE OF CONTROLLING THE DISEASE.

This disease, which at first appeared insignificant and scarcely worthy of attention, has to-day become one of the greatest dangers to the cattle industry. It is invading the States in the corn belt, and unless it can be checked will spread all over the country. The losses which it is already causing are enormous, and these will increase as the infection is more widely distributed. The very integrity of our export trade in live cattle is threatened, as it is becoming increasingly difficult to detect and exclude the exposed animals.

WORK OF THE DEPARTMENT OF AGRICULTURE.

This condition of affairs requires the most vigorous action of the Department, and plans for work are now being matured which will be put into effect as soon as the weather becomes suitable for operations

in the Northwest. In general, the measures will be similar to those adopted for sheep scab. Dipping vats must be constructed by cattle owners or others in all parts of the infected States, and the cattle must be dipped repeatedly until they are free from the disease and all the mites have disappeared from buildings and pastures. The lime-and-sulphur dip will be used exclusively for the early work, for it has shown itself superior to all other materials used, with the possible exception of the light crude petroleum from the Beaumont district (Texas), which in some trials has proved very satisfactory, but which has not yet been tried on a sufficient scale to warrant its acceptance as an official dip for this purpose. Diseased cattle will be excluded so far as possible from interstate traffic and from the principal stock yards, which constitute the great cattle markets where the interstate trade converges.

COOPERATION OF STATE GOVERNMENTS WITH THE DEPARTMENT.

The governors of a number of States have already expressed their desire to cooperate with the Department for the suppression of cattle scab, and it is therefore felt that there will be full power placed with the Bureau of Animal Industry, not only to prevent the movement of infected and exposed animals from one State to another, but to supervise and enforce the measures necessary to eradicate the disease within the different States. The eradication of the disease will be an expensive operation, but when the prosperity of the cattle industry and the integrity of the food supply of the country depend upon this being successfully accomplished there can be little doubt that Congress will be liberal in supplying the means.

Splenetic or Texas Fever.

The third disease for which the Department maintains an inspection service is the splenetic or Texas fever of cattle. This disease a few years ago was so little known and so mysterious in its character that it inspired terror wherever Southern cattle were taken; but now, owing to the investigations of the Bureau of Animal Industry, it is easily controlled without seriously interfering with the marketing of cattle from the infected district. Since it was learned that the contagion of the disease is disseminated only by the one species of ticks, known as the *Boophilus annulatus*, the regulations have been made with a view of preventing these ticks from gaining access to susceptible cattle. The section of the country infested with these ticks has been quite accurately surveyed and defined, and cattle from this section are shipped in cars which are properly placarded. When unloaded, the animals from such cars are placed in pens set apart for cattle from the infected district, and the cars are cleaned and disinfected. Cattle for immediate slaughter can thus go forward at all seasons of the year without danger of spreading the disease.

MARKETING STOCK CATTLE AFFECTED WITH TEXAS FEVER.

The problem of marketing cattle from the infected district for grazing in other parts of the country is more complicated and more difficult to regulate. These cattle travel over roads and pastures that must be used for cattle susceptible to the disease, and if they distribute ticks that are capable of propagating their species outbreaks of the disease will occur. Cattle from some parts of the infected district carry ticks upon their bodies during the whole winter, so that it is impossible to select a season of the year when it can be said with certainty that all cattle from that district are free from ticks. Fortunately, comparatively warm weather is required for the preservation and hatching of the tick eggs, and if the cattle are taken north of the infected district during November, December, and January the ticks which mature upon them drop to the ground and either do not produce any eggs, or, if eggs are produced, their vitality is destroyed before the weather becomes sufficiently warm to hatch them. The shipment of cattle from the infected district for grazing purposes has therefore been limited to the three months mentioned, but it has always been the hope of the Department that some substance would be discovered that would with certainty kill all the ticks upon these cattle and thus free them from infectious qualities.

PETROLEUM AS A DIP.

The problem of killing the ticks without injuring the cattle has been a very difficult one to solve, and experiments have been in progress for nearly ten years, only recently meeting with success. It is now believed from the results of experiments conducted during the last two years that the light petroleum, containing a considerable proportion of sulphur, produced in the Beaumont district of Texas, may be safely used as a dip for this purpose, and that a single treatment will destroy all of these parasites.

A NEW REGULATION AS TO SHIPMENT.

A provision has been inserted in the regulations of the Department for the current year permitting the shipment of cattle from the infected district, providing they are dipped in Beaumont crude petroleum, under the supervision of an inspector, and certified as free from ticks. If the results of dipping on a large scale are as favorable as in the experiments which have been made, the introduction of this method of treatment will remove the principal obstacles which the cattle industry of the South has had to contend with, and should add millions of dollars to the value of these animals in the infected States. On the other hand, it will greatly lessen the danger of infection in other sections of the country and will furnish the means for reducing the size of the permanently infected district.

APPENDIX.

SUMMARY OF INFORMATION ON VARIOUS SUBJECTS OF INTEREST TO THE FARMER.

CONTENTS.

APPENDIX.

ORGANIZATION OF THE DEPARTMENT OF AGRICULTURE.[a]

SECRETARY OF AGRICULTURE, James Wilson.

The Secretary of Agriculture is charged with the supervision of all public business relating to the agricultural industry. He makes such regulations for interstate traffic in live stock as may be necessary to prevent transmission of contagious diseases, and has charge of all interstate quarantine. He directs the admission or exclusion of live animals from foreign countries, and has charge of quarantine stations for importing cattle. He conducts the inspection and regulates the conditions of shipment of live stock and of meat products exported from American ports. He exercises advisory supervision over the agricultural experiment stations deriving support from the National Treasury.

ASSISTANT SECRETARY OF AGRICULTURE, Joseph H. Brigham.

The Assistant Secretary performs such duties as may be required by law or prescribed by the Secretary. He also becomes Acting Secretary of Agriculture in the absence of the Secretary. During the World's Fair at St. Louis and preparations therefor, he is the representative of the Department of Agriculture on the board in charge of Government exhibits and is chairman of that board.

CHIEF CLERK, S. R. Burch.

The Chief Clerk has the general supervision of the clerks and employees; he is charged with the enforcement of the internal regulations of the Department; and is, by law, superintendent of the buildings occupied by the Department of Agriculture.

APPOINTMENT CLERK, Joseph B. Bennett.

The Appointment Clerk prepares all papers involved in the making of appointments, transfers, promotions, reductions, details, furloughs, and removals for the entire Department, and decides all questions relating to the civil-service regulations affecting the same. He has charge of all correspondence of the Department with the Civil Service Commission, and of all certifications and communications issued by the Commission to the Department. He keeps the personal records of all employees of the Department, and is custodian of their oaths of office and efficiency reports. He is also custodian of the Department seal.

CHIEF OF SUPPLY DIVISION, Cyrus B. Lower.

The Supply Division has charge of purchases of supplies and materials paid for from the general funds of the Department.

BUREAUS, DIVISIONS, AND OFFICES.

WEATHER BUREAU (corner Twenty-fourth and M streets NW.).—*Chief*, Willis L. Moore; *Assistant Chief*, Henry E. Williams; *Chief Clerk*, Daniel J. Carroll; *Private Secretary to Chief*, Edgar B. Calvert; *Editor Weather Review*, Cleveland Abbe; *In charge Special Researches*, F. H. Bigelow; *In charge Instrument Division*, Charles F. Marvin; *In charge Forecast Division*, Edward B. Garriott; *Assigned as Official Forecaster*, Alfred J. Henry; *Chief of River and Flood Division*, Harry C. Frankenfield; *Chief of Climate and Crop Division*, James Berry; *In charge of Division of Meteorological Records*, William B. Stockman; *Chief of Publications Division*, John P. Church; *Chief of Telegraph Division*, Jesse H. Robinson; *Chief of Supplies Division*, Frank M. Cleaver; *Librarian and Climatologist*, William F. R. Phillips.

[a] The organization of the Department here given is in accordance with the act approved April 23, 1904, making appropriations for the fiscal year beginning July 1, 1904, and shows changes in personnel to April 1, 1904.

The Weather Bureau has charge of the forecasting of weather; the issue of storm warnings; the display of weather and flood signals for the benefit of agriculture, commerce, and navigation; the gauging and reporting of rivers; the maintenance and operation of seacoast telegraph lines, and the collection and transmission of marine intelligence for the benefit of commerce and navigation; the reporting of temperature and rainfall conditions for the cotton, rice, sugar, and other interests; the display of frost and cold-wave signals; the distribution of meteorological information in the interests of agriculture and commerce; and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or as are essential for the proper execution of the foregoing duties.

BUREAU OF ANIMAL INDUSTRY.—*Chief*, D. E. Salmon; *Assistant Chief*, A. D. Melvin; *Chief Clerk*, E. B. Jones; *Chief of Inspection Division*, A. M. Farrington; *Chief of Quarantine Division*, Richard W. Hickman; *Chief of Pathological Division*, John R. Mohler; *Chief of Biochemic Division*, M. Dorset; *Chief of Dairy Division*, Henry E. Alvord; *Acting Zoologist*, B. H. Ransom; *In charge of Experiment Station*, E. C. Schroeder; *Editor*, George F. Thompson; *Expert in Animal Husbandry*, George M. Rommel.

The Bureau of Animal Industry makes investigations as to the existence of dangerous communicable diseases of live stock, superintends the measures for their extirpation, makes original investigations as to the nature and prevention of such diseases, and reports on the condition and the means of improving the animal industries of the country. It also has charge of the inspection of import and export animals, of the inspection of vessels for the transportation of export cattle, and of the quarantine stations for imported neat cattle; supervises the interstate movement of cattle, and inspects live stock and their products when offered for food consumption; has charge of manufacture, interstate commerce, and export of renovated butter.

BUREAU OF PLANT INDUSTRY.—*Chief*, Beverly T. Galloway; *Pathologist and Physiologist, and Acting Chief in absence of Chief*, A. F. Woods; *Chief Clerk*, James E. Jones; *Botanist*, F. V. Coville; *Agrostologist*, W. J. Spillman; *Pomologist*, G. B. Brackett; *Horticulturist*, L. C. Corbett; *Botanist in charge of Seed and Plant Introduction and Distribution*, A. J. Pieters; *Editorial Clerk*, J. E. Rockwell.

The Bureau of Plant Industry studies plant life in all its relations to agriculture. It includes Vegetable Pathological and Physiological Investigations; Botanical Investigations and Experiments; Pomological Investigations; Grass and Forage Plant Investigations; Experimental Gardens and Grounds; the Arlington Experimental Farm; Congressional Seed Distribution; Seed and Plant Introduction; Tea Culture Experiments; and Investigation of Production of Domestic Sugar

BUREAU OF FORESTRY (Atlantic Building, 928–930 F street NW.).—*Forester and Chief*, Gifford Pinchot; *In charge of Forest Measurements*, Overton W. Price; *In charge of Forest Management*, Thomas H. Sherrard; *In charge of Dendrology*, George B. Sudworth; *In charge of Forest Extension*, William L. Hall; *In charge of Forest Products*, Hermann von Schrenk; *In charge of Records*, James B. Adams.

The Bureau of Forestry gives practical assistance in the conservative handling of national, State, and private forest lands; investigates methods of planting and kinds of trees for planting, and gives practical assistance to tree planters; studies commercially valuable trees to determine their best management and use; tests the strength and durability of construction timbers, railroad ties, and telephone poles, and determines the best methods of extending their life through preservative treatment; investigates forest fires, turpentine orcharding, and other forest problems; and conducts studies to ascertain necessary changes in the boundaries of existing national forest reserves and areas suitable for new reserves.

BUREAU OF CHEMISTRY (corner Fourteenth and B streets SW.).—*Chemist and Chief*, Harvey W. Wiley; *Chief, Food Laboratory*, W. D. Bigelow; *Sugar Laboratory* under direction of Chief of Bureau; *Chief, Road-Material Laboratory*, L. W. Page; *Chief, Insecticide and Agricultural Water Laboratory*, J. K. Haywood; *Chief, Dairy Laboratory*, G. E. Patrick; *Chief, Soil and Fertilizer Analysis Laboratory*, C. C. Moore; *Chief, Drug Laboratory*, L. F. Kebler; *Chief, Contracts Laboratory*, L. S. Munson; *Chief Clerk*, M. S. Tidd.

The Bureau of Chemistry investigates methods proposed for the analysis of soils, fertilizers, and agricultural products, and makes such analyses as pertain in general to the interests of agriculture. The work on foods includes the analysis of adulter-

ated products, experiments to determine the effect of adulterants on the human organism, and the investigation of food products imported into the United States. The Bureau does chemical work for some of the other Bureaus and Divisions of the Department, and for other departments of the Government which apply to the Secretary of Agriculture for such assistance.

Bureau of Soils (212–214 Thirteenth street SW.).—*Chief*, Milton Whitney; *Chief Clerk*, A. G. Rice; *Soil Physicist*, Lyman J. Briggs; *Soil Chemist*, Frank K. Cameron; *In charge Soil Survey*, Clarence W. Dorsey; *In charge of Alkali Reclamation Investigations*, Thos. H. Means; *Tobacco Expert*, George T. McNess.

The Bureau of Soils is intrusted with the investigation, survey, and mapping of soils; the investigation of the cause and prevention of the rise of alkali in the soil, and the drainage of soils; and the investigation of the methods of growing, curing, and fermentation of tobacco in the different tobacco districts.

Bureau of Entomology.—*Entomologist and Chief*, L. O. Howard; *Entomologist in charge of Experimental Field Work*, C. L. Marlatt; *Entomologist in charge of Breeding Experiments*, F. H. Chittenden; *In charge of Forestry Investigations*, A. D. Hopkins; *In charge of Apiculture*, Frank Benton; *In charge of Cotton Boll Weevil Investigations*, W. D. Hunter; *In charge of Bollworm Investigations*, A. L. Quaintance; *Expert in Sericulture*, Miss H. A. Kelly; *Assistant Entomologist*, D. W. Coquillett.

The Bureau of Entomology obtains and disseminates information regarding injurious insects affecting field crops, fruits, small fruits, and truck crops, forest and forest products, and stored products; studies insects in relation to diseases of man and other animals and as animal parasites; experiments with the introduction of beneficial insects and with the fungus and other diseases of insects, and conducts experiments and tests with insecticides and insecticide machinery. It is further charged with investigations in apiculture and sericulture. The information gained is disseminated in the form of general reports, bulletins, and circulars. A good deal of museum work is done in connection with the Division of Insects of the National Museum, and insects are identified for experiment stations and other public institutions and private individuals.

Division of Biological Survey.—*Biologist and Chief*, C. Hart Merriam; *Assistant Chief*, A. K. Fisher; *Assistant in charge of Game Preservation*, T. S. Palmer; *Assistant in charge of Economic Ornithology*, F. E. L. Beal.

The Division of Biological Survey studies the geographic distribution of animals and plants, and maps the natural life zones of the country; it also investigates the economic relations of birds and mammals, and recommends measures for the preservation of beneficial and the destruction of injurious species. It is charged with carrying into effect the provisions of the Federal law for the importation and protection of birds and certain provisions of the law for the protection of game in Alaska.

Division of Accounts and Disbursements.—*Chief and Disbursing Clerk*, Frank L. Evans; *Assistant Chief* (in charge of Weather Bureau disbursements), A. Zappone; *Cashier*, M. E. Fagan.

The Division of Accounts and Disbursements audits, adjusts, and pays all accounts and claims against the Department; decides questions involving the expenditure of public funds; prepares advertisements, schedules, contracts for annual supplies, leases, agreements, bonds, and letters of authority; writes, for the signature of the Secretary, all letters to the Treasury Department pertaining to fiscal matters and all letters to the Department of Justice; attends to litigation in which the Department is interested; issues requisitions for the purchase of supplies and requests for passenger and for freight transportation; prepares the annual estimates of appropriations; and transacts all other business relating to the financial interests of the Department.

Division of Publications.—*Editor and Chief*, Geo. Wm. Hill; *Associate Editor*, Joseph A. Arnold; *Assistant Editor*, B. D. Stallings; *Assistant in charge of Document Section*, R. B. Handy.

The Division of Publications exercises general supervision of the Department printing and illustrations, edits all publications of the Department (with the exception of those of the Weather Bureau), has charge of the printing and Farmers' Bulletin funds, and distributes all Department publications with the exception of those turned over by law to the Superintendent of Documents for sale at the price affixed by him; it issues, in the form of press notices, official information of interest to agri-

culturists, and distributes to agricultural publications and writers notices and synopses of Department publications; and has charge of all correspondence with the Government Printing Office.

BUREAU OF STATISTICS.—*Statistician and Chief,* John Hyde; *Associate Statistician,* Edwin S. Holmes, jr.; *Assistant Statistician and Chief,* Stephen D. Fessenden; *Chief, Division of Foreign Markets,* George K. Holmes; *Chief, Division of Crop Reporting,* Victor H. Olmsted.

The Statistician collects information as to the condition, production, etc., of the principal crops and the status of farm animals through State agents, each of whom is assisted by a corps of local reporters, through separate corps of county, township, and cotton correspondents, through traveling agents, and through a special foreign correspondent, assisted by consular, agricultural, and commercial authorities. He records, tabulates, and coordinates statistics of agricultural production, distribution, and consumption, the authorized data of governments, institutes, societies, boards of trade, and individual experts; prepares special statistical bulletins upon agricultural subjects, and issues a monthly crop report for the information of producers and consumers. Through the division of foreign markets, which has for its object the extension of the agricultural export trade of the United States, the Statistician investigates the requirements of foreign markets, studies the conditions of demand and supply as disclosed by the records of production, importation, and exportation; inquires into the obstacles confronting trade extension, and disseminates, through printed reports and otherwise, the information collected.

LIBRARY.—*Librarian,* Josephine A. Clark; *Assistant Librarian,* Claribel R. Barnett.

The Librarian has charge of the Library and supervises the arrangement and cataloguing of books, the preparation of bibliographies and similar publications, and the purchase of new books. The mailing lists for the distribution of Department publications to foreign countries are under the supervision of the Librarian.

OFFICE OF EXPERIMENT STATIONS.—*Director,* A. C. True; *Assistant Director and Editor of Experiment Station Record,* E. W. Allen; *Chief of Editorial Division,* W. H. Beal; *Chief of Division of Insular Stations,* W. H. Evans; *Special Agent, Alaska,* C. C. Georgeson; *Special Agent, Hawaii,* Jared G. Smith; *Special Agent, Porto Rico,* D. W. May; *Chief of Nutrition Investigations,* W. O. Atwater; *Chief of Irrigation Investigations,* Elwood Mead; *Farmers' Institute Specialist,* John Hamilton; *Chief Clerk,* Mrs. C. E. Johnston.

The Office of Experiment Stations represents the Department in its relation to the experiment stations, which are now in operation in all the States and Territories, and directly manages the experiment stations in Alaska, Porto Rico, and Hawaii. It seeks to promote the interests of agricultural education and investigation throughout the United States. It collects and disseminates general information regarding the colleges and stations, and publishes accounts of agricultural investigations at home and abroad. It also indicates lines of inquiry of the stations, aids in the conduct of cooperative experiments, reports upon their expenditures and work, and in general furnishes them with such advice and assistance as will best promote the purposes for which they were established. In a similar way it aids in the development of the farmers' institutes throughout the United States. It is charged with investigations on the nutritive value and economy of human foods. It conducts investigations of the laws and institutions relating to irrigation in different regions, the use of irrigation waters, the removal of seepage and surplus waters by drainage, and the use of different kinds of power for irrigation and other agricultural purposes.

OFFICE OF PUBLIC ROAD INQUIRIES.—*Director,* Martin Dodge; *Assistant Director,* Maurice O. Eldridge.

The Office of Public Road Inquiries collects and disseminates information concerning the systems of road management throughout the United States, conducts investigations and experiments regarding the best method of road making, the best kinds of road-making materials, and prepares publications on these subjects.

APPROPRIATIONS FOR THE DEPARTMENT OF AGRICULTURE FOR THE FISCAL YEARS ENDING JUNE 30, 1902, 1903, AND 1904.

Object of Appropriation.	1902.	1903.	1904.
Salaries, Department of Agriculture	$373,820.00	$465,500.00	$471,080.00
Library, Department of Agriculture	7,000.00	8,000.00	10,000.00
Contingent Expenses, Department of Agriculture	37,000.00	[a]43,000.00	37,000.00
Animal Quarantine Stations	25,000.00	....	
Collecting Agricultural Statistics	120,000.00	94,200.00	109,200.00
Botanical Investigations and Experiments	45,000.00	55,000.00	65,000.00
Entomological Investigations	[b]28,513.18	45,500.00	65,500.00
Vegetable Pathological Investigations	60,000.00	110,000.00	130,000.00
Biological Investigations	20,000.00	28,000.00	34,000.00
Pomological Investigations	20,000.00	30,000.00	37,000.00
Laboratory, Department of Agriculture	24,500.00	60,500.00	70,500.00
Forestry Investigations	146,280.00	254,000.00	312,860.00
Experimental Gardens and Grounds, Department of Agriculture	20,000.00	25,000.00	25,000.00
Soil Investigations	91,000.00	130,000.00	170,000.00
Grass and Forage Plant Investigations	20,000.00	30,000.00	35,000.00
Agricultural Experiment Stations [for stations under Hatch act, $789,000, 1902; $796,000, 1903; $810,000, 1904]	[c]69,000.00	[c]76,000.00	90,000.00
Nutrition Investigations	20,000.00	20,000.00	20,000.00
Public Road Inquiries	20,000.00	30,000.00	35,000.00
Cotton Boll-Weevil Investigations, 1904-5	....	....	170,000.00
Publications, Department of Agriculture	[d]188,000.00	[e]204,000.00	200,000.00
Sugar Investigations	5,000.00	5,000.00	5,000.00
Purchase and Distribution of Valuable Seeds	270,000.00	270,000.00	290,000.00
Salaries and Expenses, Bureau of Animal Industry	[f]1,090,000.00	[g]1,660,000.00	1,450,000.00
Irrigation Investigations	50,000.00	65,000.00	65,000.00
Tea Culture Investigations	7,000.00	10,000.00	10,000.00
Arlington Experimental Farm	10,000.00	15,000.00	15,000.00
Plans for Building, Department of Agriculture	5,000.00	....	....
Foreign Market Investigations	....	6,500.00	7,500.00
Silk Investigations	....	10,000.00	....
Building, Department of Agriculture	....	....	250,000.00
Total	2,772,113.18	3,750,200.00	4,179,640.00
WEATHER BUREAU.			
Salaries, Weather Bureau	159,820.00	165,260.00	175,440.00
Fuel, Lights, and Repairs, Weather Bureau	9,000.00	10,000.00	6,000.00
Contingent Expenses, Weather Bureau	8,000.00	8,000.00	8,000.00
General Expenses, Weather Bureau	865,500.00	915,500.00	969,080.00
Meteorological Observation Stations	60,000.00	60,000.00	....
Buildings, Weather Bureau	46,000.00	50,000.00	50,000.00
Cables and Land Lines, Weather Bureau	....	40,000.00	40,000.00
Storm-warning Stations, Glenhaven and South Manitou Island, Mich., Weather Bureau	....	15,000.00	....
Total, Weather Bureau	1,148,320.00	1,263,760.00	1,248,520.00
Grand total	3,920,433.18	5,013,960.00	5,428,160.00

[a] Includes $6,000 deficiency.
[b] Includes $3,013.18 deficiency.
[c] Expenses of Office of Experiment Stations.
[d] Includes $15,000 deficiency, but does not include $300,000 for Yearbook and $150,000 in general fund.
[e] Includes $4,000 deficiency, but does not include $300,000 for Yearbook and $185,000 in general fund.
[f] Includes $40,000 deficiency.
[g] Includes $500,000 deficiency, emergency fund for foot-and-mouth disease.

PROPOSED NEW BUILDINGS FOR THE DEPARTMENT OF AGRICULTURE.

By B. T. GALLOWAY, *Chairman, Building Committee.*

The new buildings (see frontispiece and Pl. LXII) for the United States Department of Agriculture will be located on the south side of the Department grounds near the highest point in that part of Washington originally laid out as the Mall. The grounds proper comprise an area of 40 acres. The plans provide for the erection of three structures, each of which will be complete in itself. Two of these structures will be devoted entirely to laboratory purposes and one to administrative use. The laboratories

will each have a frontage of 256 feet and will be connected by covered curtains or corridors with the administration building, which will be monumental in character and which will form the center of the group. Extending back from one end of each of the main laboratory structures will be a wing 100 feet in length. Thus there will be formed a large court, with the entire south end open. This arrangement will give excellent light and ventilation.

The laboratories are to be five stories in height, including the basement, which will be for the most part above ground. The rooms will all be well lighted, and special provision will be made for heating and ventilation in accordance with the best modern methods for such structures. In preparing the plans for these buildings, the fact was kept in mind that they were to be used for working purposes. Everything about the buildings will be thoroughly fireproof and substantial; and the rooms will be so arranged that, no matter what changes are effected in organization in future years, each room will be well adapted for laboratory purposes. Each room will be fully provided with all the necessary equipments for biological, chemical, or physical work.

The administration structure is designed to combine dignity, beauty, and utility. There is no waste space, and the offices will all be arranged in such a way that each will have outside light. The main feature of this building consists of a central court surrounded by corridors, from which the various offices are reached. This building, like the others, will be constructed of the very best materials, and will be absolutely fireproof throughout. The structure will be six stories in height, including the basement. The library of the Department, which is now one of the most valuable of its kind in the country, will be located on the top floor of the administration building, where ample light will be at hand and where the quiet and other requirements so necessary for library work will be available. The administration building and laboratories will present a façade about 650 feet in length. The buildings will be constructed either of marble or of white granite, and, placed as they are among the beautiful surroundings of the Department grounds, will form one of the most imposing structures in the city.

AGRICULTURAL COLLEGES AND OTHER INSTITUTIONS IN THE UNITED STATES HAVING COURSES IN AGRICULTURE.[a]

College instruction in agriculture is given in the colleges and universities receiving the benefits of the acts of Congress of July 2, 1862, and August 30, 1890, which are now in operation in all the States and Territories, except Alaska, Hawaii, and Porto Rico. The total number of these institutions is 66, of which 63 maintain courses of instruction in agriculture. In 20 States the agricultural colleges are departments of the State universities. In 16 States and Territories separate institutions having courses in agriculture are maintained for the colored race. All of the agricultural colleges for white persons and several of those for negroes offer four-year courses in agriculture and its related sciences leading to bachelors' degrees, and many provide for graduate study. Forty-four of these institutions also provide special, short, and correspondence courses in the different branches of agriculture, including agronomy, horticulture, animal husbandry, poultry culture, cheese making, dairying, sugar making, rural engineering, farm mechanics, and other technical subjects. The officers of the agricultural colleges engage quite largely in conducting farmers' institutes and other forms of college extension. The agricultural experiment stations with very few exceptions are departments of the agricultural colleges. The total number of persons engaged in the work of education and research in the land-grant colleges and the experiment stations in 1903 was 4,359; the number of students in these colleges, 52,489; the number of students in the four-year college courses in agriculture, 3,146; in short and special courses, 5,505. With a few exceptions each of these colleges offers free tuition to residents of the States in which it is located. In the excepted cases scholarships are open to promising and energetic students; and in all opportunities are found for some to earn part of their expenses by their own labor. The expenses are from $125 to $300 for the school year.

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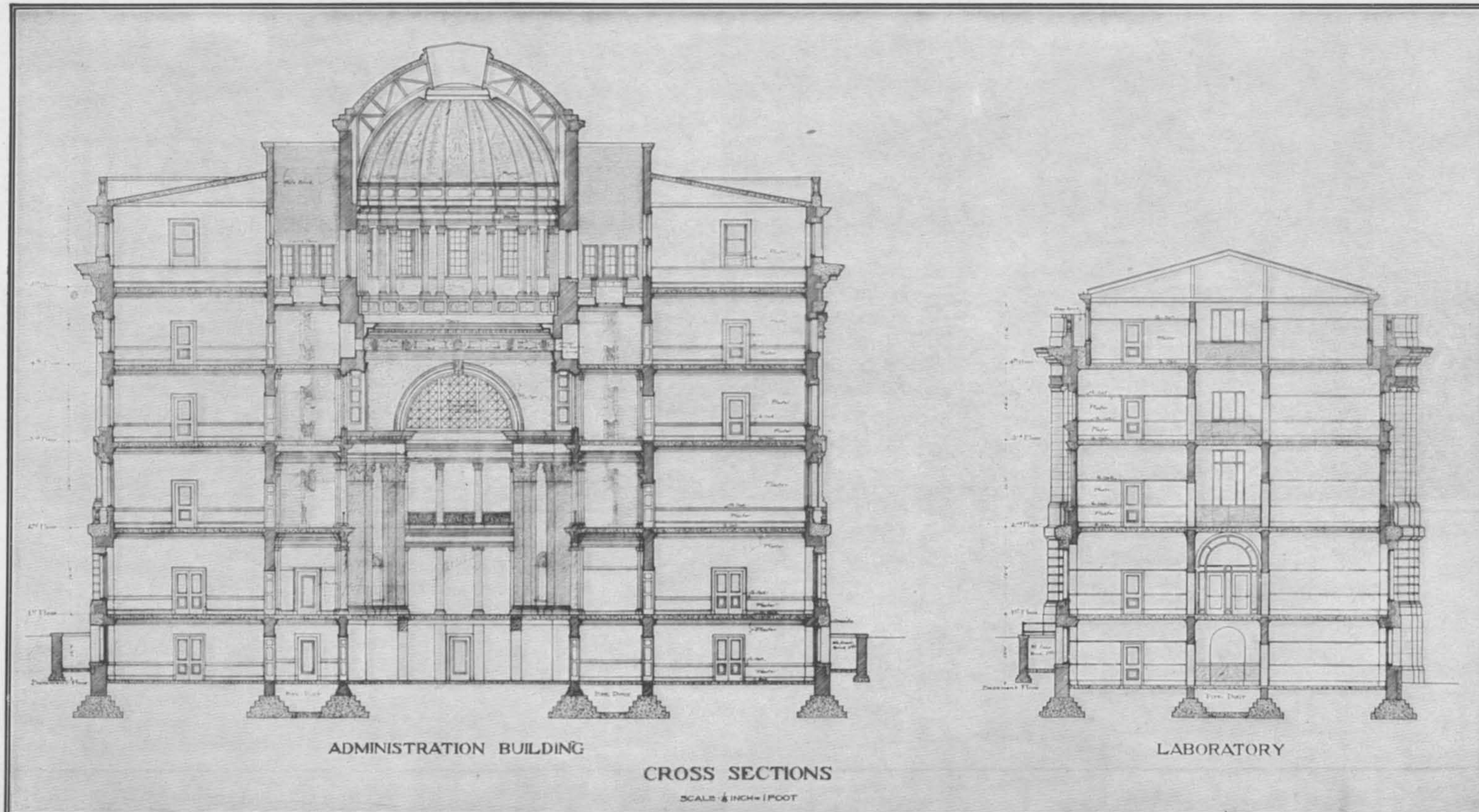
[a] Including only institutions established under the land-grant act of July 2, 1862.



CROSS SECTIONS OF ADMINISTRATION AND LABORATORY BUILDINGS FOR DEPARTMENT OF AGRICULTURE, SHOWING ARRANGEMENT OF CORRIDORS, ROOMS, ETC.

[For north elevation, see Frontispiece.]

Agricultural colleges and other institutions in the United States having courses in agriculture—Continued.

States and Territories.	Name of institution.	Location.	President.
Alabama	Alabama Polytechnic Institute.	Auburn	C. C. Thach, M. A.
	Agricultural and Mechanical College for Negroes.	Normal	W. H. Councill, Ph. D.
Arizona	University of Arizona	Tucson	K. C. Babcock, Ph. D.
Arkansas	University of Arkansas	Fayetteville	H. S. Hartzog, LL. D.
	Branch Normal College	Pine Bluff	Isaac Fisher.
California	University of California	Berkeley	B. I. Wheeler, LL. D.
Colorado	The State Agricultural College of Colorado.	Fort Collins	B. O. Aylesworth, LL. D.
Connecticut	Conn. Agricultural College	Storrs	R. W. Stimson, M. A.
Delaware	Delaware College	Newark	G. A. Harter, Ph. D.
	State College for Colored Students.	Dover	W. C. Jason, M. A.
Florida	Florida Agricultural College	Lake City	T. H. Taliaferro, Ph. D.
	Florida State Normal and Industrial College.	Tallahassee	N. B. Young, M. A.
Georgia	Georgia State College of Agriculture and Mechanic Arts.	Athens	H. C. White, Ph. D.
	Georgia State Industrial College.	College	R. R. Wright.
Idaho	University of Idaho	Moscow	J. A. McLean, Ph. D.
Illinois	University of Illinois	Urbana	A. S. Draper, LL. D.
Indiana	Purdue University	Lafayette	W. E. Stone, Ph. D.
Iowa	Iowa State College of Agriculture and the Mechanic Arts.	Ames	A. B. Storms, D. D.
Kansas	Kansas State Agricultural College.	Manhattan	E. R. Nichols, M. A.
Kentucky	Agricultural and Mechanical College of Kentucky.	Lexington	J. K. Patterson, LL. D.
	State Normal School for Colored Students.	Frankfort	J. S. Hathaway, M. A., M. D.
Louisiana	Louisiana State University and Agricultural and Mechanical College.	Baton Rouge	T. D. Boyd, LL. D.
	Southern University and Agricultural and Mechanical College.	New Orleans	H. A. Hill.
Maine	The University of Maine	Orono	G. E. Fellows, Ph. D.
Maryland	Maryland Agricultural College.	College Park	R. W. Silvester.
	Princess Anne Academy, Eastern Branch, Md. Agr. Coll.	Princess Anne	F. Trigg, M. A.
Massachusetts	Massachusetts Agricultural College.	Amherst	H. H. Goodell, LL. D.
Michigan	Michigan State Agricultural College.	Agricultural College.	J. L. Snyder, Ph. D.
Minnesota	The University of Minnesota	St. Anthony Park.	C. Northrop, LL. D.
Mississippi	Mississippi Agricultural and Mechanical College.	Agricultural College.	J. C. Hardy, M. A.
	Alcorn Agricultural and Mechanical College.	Westside	W. H. Lanier, B. A.
Missouri	The University of Missouri	Columbia	R. H. Jesse, LL. D.
	Lincoln Institute	Jefferson City	B. F. Allen, M. A.
Montana	The Montana College of Agriculture and Mechanic Arts.	Bozeman	J. Reid, B. A.
Nebraska	The University of Nebraska	Lincoln	E. B. Andrews, LL. D.
Nevada	Nevada State University	Reno	J. E. Stubbs, M. A., D. D.
New Hampshire	The New Hampshire College of Agriculture and the Mechanic Arts.	Durham	W. D. Gibbs, M. S.
New Jersey	Rutgers Scientific School (The New Jersey State College for the Benefit of Agriculture and the Mechanic Arts).	New Brunswick	Austin Scott, LL. D.
New Mexico	The New Mexico College of Agriculture and Mechanic Arts.	Mesilla Park	Luther Foster, M. S. A.
New York	Cornell University	Ithaca	J. G. Schurman, LL. D.
North Carolina	The North Carolina College of Agriculture and Mechanic Arts.	West Raleigh	G. T. Winston, LL. D.
	The Agricultural and Mechanical College for the Colored Race.	Greensboro	J. B. Dudley, M. A.
North Dakota	North Dakota Agricultural College.	Agricultural College.	J. H. Worst, LL. D.
Ohio	Ohio State University	Columbus	W. O. Thompson, D. D.
Oklahoma	Oklahoma Agricultural and Mechanical College.	Stillwater	A. C. Scott, LL. M.
	Agricultural and Normal University.	Langston	I. E. Page, M. A.
Oregon	Oregon State Agricultural College.	Corvallis	T. M. Gatch, Ph. D.
Pennsylvania	The Pennsylvania State College.	State College	G. W. Atherton, LL. D.

Agricultural colleges and other institutions in the United States having courses in agriculture—Continued.

States and Territories.	Name of institution.	Location.	President.
Rhode Island	Rhode Island College of Agriculture and Mechanic Arts.	Kingston	K. L. Butterfield, M. S.
South Carolina	Clemson Agricultural College	Clemson College	P. H. Mell, Ph. D.
	The Colored Normal, Industrial, Agricultural, and Mechanical College of South Carolina.	Orangeburg	T. E. Miller, LL. D.
South Dakota	South Dakota Agricultural College.	Brookings	James Chalmers, Ph. D.
Tennessee	University of Tennessee	Knoxville	
Texas	State Agricultural and Mechanical College of Texas.	College Station	D. F. Houston, LL. D.
	Prairie View State Normal School.	Prairie View	E. L. Blackshear.
Utah	The Agricultural College of Utah.	Logan	W. J. Kerr, D. Sc.
Vermont	University of Vermont and State Agricultural College.	Burlington	M. H. Buckham, LL. D.
Virginia	The Virginia Agricultural and Mechanical College and Polytechnic Institute.	Blacksburg	J. M. McBryde, LL. D.
	The Hampton Normal and Agricultural Institute.	Hampton	H. B. Frissell, LL. D.
Washington	Washington Agricultural College and School of Science.	Pullman	E. A. Bryan, M. A.
West Virginia	West Virginia University	Morgantown	D. B. Purinton, LL. D.
	The West Virginia Colored Institute.	Institute	J. McH. Jones.
Wisconsin	University of Wisconsin	Madison	C. R. Van Hise, Ph. D.
Wyoming	University of Wyoming	Laramie	C. W. Lewis, D. D.

AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES, THEIR LOCATIONS, DIRECTORS, AND PRINCIPAL LINES OF WORK.

Stations, locations, and directors.	Principal lines of work.
Alabama (College), Auburn: J. F. Duggar	Botany; soils; analyses of fertilizers and food materials; agronomy; horticulture; plant breeding; diseases of plants and animals; feeding experiments; dairying.
Alabama (Canebrake), Uniontown: J. M. Richeson	Agronomy; horticulture; floriculture; diseases of plants and animals; dairying.
Alabama (Tuskegee), Tuskegee: G. W. Carver	Agronomy; horticulture; diseases of plants; animal industry; dairying.
Arizona, Tucson: R. H. Forbes	Chemistry; botany; agronomy; horticulture; feeding experiments; irrigation.
Arkansas, Fayetteville: W. G. Vincenheller	Chemistry; agronomy; horticulture; plant breeding; diseases of plants and animals; feeding experiments.
California, Berkeley: E. W. Hilgard	Physics; chemistry; bacteriology; fertilizers; agronomy; horticulture; botany; meteorology; technology of wine and olive oil; animal husbandry; entomology; dairying; drainage and irrigation; animal and plant pathology.
Colorado, Fort Collins: L. G. Carpenter	Chemistry; agronomy; horticulture; plant breeding; entomology; irrigation.
Connecticut (State), New Haven: E. H. Jenkins	Chemistry; inspection of fertilizers, foods, feeding stuffs, Babcock test apparatus, and nurseries; diseases of plants; horticulture; forestry; agronomy; entomology.
Connecticut (Storrs), Storrs: L. A. Clinton	Nutrition investigations; dairy bacteriology; agronomy; horticulture; poultry culture; dairying.
Delaware, Newark: A. T. Neale	Chemistry; bacteriology; agronomy; horticulture; diseases of plants and animals; feeding experiments; entomology; dairying.
Florida, Lake City: T. H. Taliaferro	Agronomy; horticulture; feeding experiments; veterinary science; entomology.
Georgia, Experiment: R. J. Redding	Agronomy; horticulture; entomology; pig feeding; dairying.
Idaho, Moscow: H. T. French	Chemistry; physics; botany; agronomy; horticulture; entomology; feeding experiments.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Stations, locations, and directors.	Principal lines of work.
Illinois, Urbana: E. Davenport	Chemistry; bacteriology; agronomy; horticulture; forestry; plant breeding; diseases of plants and animals; feeding experiments; entomology; dairying.
Indiana, Lafayette: Arthur Goss	Chemistry; agronomy; horticulture; feeding experiments; diseases of plants and animals; irrigation; dairying.
Iowa, Ames: C. F. Curtiss	Chemistry; botany; agronomy; horticulture; diseases of plants; feeding experiments; entomology; dairying.
Kansas, Manhattan: J. T. Willard	Soils; horticulture; plant breeding; agronomy; feeding and digestion experiments; diseases of animals; entomology; dairying.
Kentucky, Lexington: M. A. Scovell	Chemistry; soils; inspection of fertilizers, foods, feeding stuffs, orchards, and nurseries; agronomy; horticulture; plant breeding; animal husbandry; diseases of plants; entomology; dairying.
Louisiana (Sugar), New Orleans: William C. Stubbs	Chemistry; bacteriology; soils; agronomy; horticulture; sugar making; drainage; irrigation.
Louisiana (State), Baton Rouge: William C. Stubbs	Chemistry; geology; botany; bacteriology; soils; inspection of fertilizers and Paris green; agronomy; horticulture; animal husbandry; diseases of animals; entomology.
Louisiana (North), Calhoun: William C. Stubbs	Chemistry; soils; fertilizers; field experiments; horticulture; feeding experiments; stock raising; dairying.
Maine, Orono: C. D. Woods	Chemistry; botany; inspection of fertilizers, commercial feeding stuffs, and creamery glassware; horticulture; diseases of plants and animals; food and nutrition of man and animals; poultry raising; entomology; dairying.
Maryland, College Park: H. J. Patterson	Chemistry; agronomy; horticulture; diseases of plants and animals; breeding of plants; feeding experiments; entomology; dairying.
Massachusetts, Amherst: H. H. Goodell	Chemistry; meteorology; inspection of fertilizers, commercial feeding stuffs, creamery glassware, and nurseries; agronomy; horticulture; diseases of plants and animals; digestion and feeding experiments; entomology; dairying.
Michigan, Agricultural College: C. D. Smith	Chemistry; bacteriology; soils; agronomy; horticulture; diseases of plants and animals; feeding experiments; entomology; stable hygiene.
Minnesota, St. Anthony Park, St. Paul: W. M. Liggett	Chemistry; soils; agronomy; horticulture; forestry; diseases of plants and animals; food and nutrition investigations; plant and animal breeding; feeding experiments; entomology; dairying.
Mississippi, Agricultural College: W. L. Hutchinson	Soils; fertilizers; agronomy; horticulture; animal husbandry; diseases of animals; entomology; dairying.
Missouri (College), Columbia: F. B. Mumford [a]	Chemistry; agronomy; horticulture; diseases of plants and animals; feeding experiments; animal and plant breeding; entomology; dairying; irrigation.
Missouri (Fruit), Mountain Grove: Paul Evans	Horticulture; entomology; inspection of orchards and nurseries.
Montana, Bozeman: F. B. Linfield [a]	Chemistry; meteorology; botany; agronomy; horticulture; feeding experiments; poultry experiments; entomology; irrigation.
Nebraska, Lincoln: E. A. Burnett	Chemistry; botany; meteorology; soils; agronomy; horticulture; diseases of plants and animals; forestry; feeding and breeding experiments; entomology; dairying; irrigation.
Nevada, Reno: J. E. Stubbs	Chemistry; botany; soils; agronomy; horticulture; forestry; animal diseases; entomology; irrigation.
New Hampshire, Durham: W. D. Gibbs	Chemistry; agronomy; horticulture; feeding experiments; entomology.
New Jersey (State), New Brunswick: E. B. Voorhees	Chemistry; biology; botany; analysis of fertilizers, foods, and commercial feeding stuffs; agronomy; horticulture; diseases of plants and animals; nutrition investigations; entomology; dairy husbandry; soil bacteriology; irrigation.
New Jersey (College), New Brunswick: E. B. Voorhees	
New Mexico, Mesilla Park: Luther Foster	Chemistry; botany; soils; agronomy; horticulture; feeding experiments; entomology; irrigation.

[a] Acting director.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Stations, locations, and directors.	Principal lines of work.
New York (State), Geneva: W. H. Jordan	Chemistry; bacteriology; meteorology; inspection of creamery glassware, feeding stuffs, fertilizers, and Paris green; agronomy; horticulture; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; irrigation.
New York (Cornell), Ithaca: L. H. Bailey	Chemistry; fertilizers; agronomy; horticulture; diseases of plants and animals; feeding experiments; poultry experiments; entomology; dairying.
North Carolina, Raleigh: B. W. Kilgore	Chemistry; soils; agronomy; horticulture; animal husbandry; diseases of animals and plants; poultry experiments; dairying.
North Dakota, Agricultural College: J. H. Worst	Chemistry; botany; agronomy; plant breeding; horticulture; diseases of plants and animals; food analysis; feeding experiments; dairying; farm mechanics.
Ohio, Wooster: C. E. Thorne	Agronomy; horticulture; plant breeding; diseases of plants and animals; breeding and feeding experiments; entomology.
Oklahoma, Stillwater: John Fields	Chemistry; agronomy; horticulture; forestry; botany; diseases of plants and animals; animal husbandry; entomology.
Oregon, Corvallis: J. Withycombe	Chemistry; bacteriology; agronomy; horticulture; diseases of plants; feeding experiments; entomology; dairying.
Pennsylvania, State College: H. P. Armsby	Chemistry; meteorology; analysis of fertilizers, foods, and feeding stuffs; horticulture; agronomy; feeding experiments; dairying.
Rhode Island, Kingston: H. J. Wheeler	Chemistry; meteorology; soils; inspection of fertilizers and feeding stuffs; agronomy; horticulture; poultry experiments.
South Carolina, Clemson College: P. H. Mell	Chemistry; inspection of fertilizers; agronomy; horticulture; plant breeding; diseases of plants; feeding experiments; veterinary science; entomology; dairying.
South Dakota, Brookings: J. W. Wilson	Agronomy; plant breeding; diseases of plants and animals; animal husbandry; dairying; irrigation.
Tennessee, Knoxville: A. M. Soule	Chemistry; fertilizers; agronomy; horticulture; seeds; weeds; diseases of plants; feeding experiments; entomology; dairying.
Texas, College Station: J. A. Craig	Chemistry; meteorology; agronomy; horticulture; feeding experiments; diseases of animals; irrigation.
Utah, Logan: J. A. Widtsoe	Chemistry; alkali soil investigations; meteorology; agronomy; horticulture; diseases of plants; breeding and feeding experiments; dairying; poultry experiments; irrigation; arid farming.
Vermont, Burlington: J. L. Hills	Chemistry; botany; inspection of fertilizers, feeding stuffs, and creamery glassware; agronomy; horticulture; diseases of plants; feeding experiments; dairying.
Virginia, Blacksburg: J. M. McBryde	Agronomy; horticulture; bacteriology; analysis of foods; feeding experiments; veterinary science; entomology; cider and vinegar making; ferments.
Washington, Pullman: E. A. Bryan	Chemistry; botany; bacteriology; agronomy; horticulture; plant breeding; diseases of plants and animals; feeding and breeding experiments; oyster culture; entomology; dairying; irrigation.
West Virginia, Morgantown: J. H. Stewart	Chemistry; inspection of fertilizers, orchards, and nurseries; agronomy; horticulture; diseases of plants; feeding experiments; poultry experiments; entomology; dairying.
Wisconsin, Madison: W. A. Henry	Chemistry; bacteriology; soils; agronomy; horticulture; feeding experiments; dairying; drainage and irrigation.
Wyoming, Laramie: B. C. Buffum	Chemistry; geology; botany; meteorology; range improvement; fertilizers; agronomy; food analysis; breeding and feeding experiments; poultry experiments; entomology; irrigation.

OFFICIALS IN CHARGE OF FARMERS' INSTITUTES.

Farmers' Institute Specialist, Department of Agriculture.

John Hamilton, Washington, District of Columbia.

State superintendents.

State.	Name of official.	Post-office.
Alabama	C. A. Cary, Alabama Polytechnic Institute	Auburn.
	G. W. Carver, Agricultural Experiment Station	Tuskegee.
Alaska	C. C. Georgeson, Agricultural Experiment Station	Sitka.
Arizona	R. H. Forbes, Agricultural Experiment Station	Tucson.
Arkansas	H. S. Hartzog, University of Arkansas	Fayetteville.
California	E. J. Wickson, University of California	Berkeley.
Colorado	A. M. Hawley, Secretary State Board of Agriculture	Fort Collins.
Connecticut	J. F. Brown, Secretary State Board of Agriculture	N. Stonington.
	J. O. Noble, Secretary Connecticut Dairymen's Association	Hartford.
	H. C. C. Miles, Secretary Connecticut Pomological Society	Milford.
Delaware	Wesley Webb, Director of Farmers' Institutes	Dover.
Florida	C. M. Conner, Agricultural College	Lake City.
Georgia	H. C. White, President State College of Agriculture	Athens.
	Harvie Jordan, Director of Farmers' Institutes	Monticello.
Hawaii	J. G. Smith, Agricultural Experiment Station	Honolulu.
Idaho	H. T. French, Agricultural Experiment Station	Moscow.
Illinois	A. B. Hostetter, Secretary Farmers' Institutes	Springfield.
Indian Territory		
Indiana	W. C. Latta, Director Farmers' Institutes	Lafayette.
Iowa	J. C. Simpson, Secretary State Board of Agriculture	Des Moines.
Kansas	J. T. Willard, State Agricultural College	Manhattan.
Kentucky	Hubert Vreeland, Commissioner of Agriculture	Frankfort.
Louisiana	J. G. Lee, Commissioner of Agriculture	Baton Rouge.
Maine	A. W. Gilman, Commissioner of Agriculture	Augusta.
Maryland	W. L. Amoss, Director Farmers' Institutes	Benson.
Massachusetts	J. L. Ellsworth, Secretary State Board of Agriculture	Boston.
Michigan	L. R. Taft, Director Farmers' Institutes	Agricultural College.
Minnesota	O. C. Gregg, Director Farmers' Institutes	Lynd.
Mississippi	J. C. Hardy, President Ag'l and Mechanical College	Agricultural College.
Missouri	Geo. B. Ellis, Secretary State Board of Agriculture	Columbia.
Montana	F. B. Linfield, President College of Agriculture	Bozeman.
Nebraska	E. A. Burnett, Director Agricultural Experiment Station	Lincoln.
Nevada	J. E. Stubbs, Director Agricultural Experiment Station	Reno.
New Hampshire	N. J. Bachelder, Secretary State Board of Agriculture	Concord.
New Jersey	Franklin Dye, Secretary State Board of Agriculture	Trenton.
New Mexico	J. D. Tinsley	Mesilla Park.
New York	F. E. Dawley, Director of Farmers' Institutes	Fayetteville.
North Carolina	S. L. Patterson, Commissioner of Agriculture	Raleigh.
North Dakota	E. E. Kaufman, Secretary Farmers' Institute Board	Fargo.
Ohio	W. W. Miller, Secretary State Board of Argriculture	Columbus.
Oklahoma	J. B. Thoburn, Secretary Board of Agriculture	Guthrie.
Oregon	J. Withycombe, Director Agricultural Experiment Station	Corvallis.
Pennsylvania	A. L. Martin, Deputy Secretary of Agriculture	Harrisburg.
Porto Rico	W. H. Elliott, Director of Farmers' Institutes	San Juan.
Rhode Island	John G. Clarke, Secretary State Board of Agriculture	Providence.
South Carolina	J. S. Newman, Director Farmers' Institutes	Clemson College.
	Thos. E. Miller, Agricultural and Mechanical College	Orangeburg.
Tennessee	W. W. Ogilvie, Commissioner of Agriculture	Nashville.
Texas	R. L. Bennett, Director Farmers' Institutes	Dallas.
Utah	John A. Widtsoe, Agricultural College	Logan.
Vermont	C. J. Bell, Secretary State Board of Agriculture	East Hardwick.
Virginia	G. W. Koiner, Commissioner of Agriculture	Richmond.
Washington	E. A. Bryan, Director Agricultural Experiment Station	Pullman.
West Virginia	J. B. Garvin, Director of Institutes	Charleston.
Wisconsin	G. McKerrow, Director Farmers' Institutes	Madison.
Wyoming	Chas. W. Lewis, President University of Wyoming	Laramie.

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

President, W. O. Thompson, president of Ohio State University, Columbus, Ohio; secretary-treasurer, E. B. Voorhees, director of New Jersey experiment stations, New Brunswick, N. J.

AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS.

President, B. W. Kilgore, director North Carolina Experiment Station, West Raleigh, N. C.; secretary-treasurer, G. C. Creelman, president Ontario Agricultural College, Guelph, Ontario.

STATE OFFICIALS IN CHARGE OF AGRICULTURE.[a]

Commissioners of agriculture.

States and Territories.	Name of official.	Post-office.
Alabama	R. R. Poole	Montgomery.
Arkansas	H. T. Bradford	Little Rock.
Florida	B. E. McLin	Tallahassee.
Georgia	O. B. Stevens	Atlanta.
Kentucky	Hubert Vreeland	Frankfort.
Louisiana	J. G. Lee	Baton Rouge
Maine	A. W. Gilman	Augusta.
Montana	J. A. Ferguson	Helena.
New York	Chas. A. Wieting	Albany.
North Carolina	S. L. Patterson	Raleigh.
North Dakota	R. J. Turner	Bismarck.
New Mexico	J. W. Raynolds, Secretary of State	Santa Fe.
Pennsylvania	N. B. Critchfield, Secretary of Agriculture	Harrisburg.
Philippine Islands	F. Lamson-Scribner, Chief, Bur. of Agriculture	Manila.
Porto Rico	Wm. H. Elliott, Commissioner of the Interior	San Juan.
Tennessee	W. W. Ogilvie	Nashville.
Texas	W. J. Clay	Austin.
Virginia	Geo. W. Koiner	Richmond.
Washington	A. W. Frater, Deputy Secretary of State	Olympia.

Secretaries of State boards of agriculture.

States and Territories.	Name of official.	Post-office.
California	Harry Lowden, Acting Secretary	Sacramento.
Colorado	A. M. Hawley	Fort Collins.
Connecticut	J. F. Brown	North Stonington.
Delaware	Wesley Webb	Dover.
Hawaii	C. S. Holloway	Honolulu.
Idaho	A. E. Gibson, Sec. State Bd. Horticulture	Boise.
Illinois	W. C. Garrard	Springfield.
Indiana	Chas. Downing	Indianapolis.
Iowa	J. C. Simpson	Des Moines.
Kansas	F. D. Coburn	Topeka.
Maryland	Wm. T. P. Turpin, Supt. of Immigration	Centerville.
Massachusetts	J. L. Ellsworth	Boston.
Michigan	Addison M. Brown	Agricultural College.
Minnesota	E. W. Randall, Sec. State Ag'l Society	Hamline.
Missouri	George B. Ellis	Columbia.
Nebraska	Robt. W. Furnas	Brownville.
Nevada	Louis Bevier	Carson City.
New Hampshire	N. J. Bachelder	Concord.
New Jersey	Franklin Dye	Trenton.
North Carolina	T. K. Bruner	Raleigh.
Ohio	W. W. Miller	Columbus.
Oklahoma	J. B. Thoburn	Guthrie.
Oregon	M. D. Wisdom	Portland.
Rhode Island	John G. Clarke	Providence.
South Dakota	Walter B. Dean	Yankton.
Vermont	C. J. Bell	East Hardwick.
West Virginia	J. O. Thompson	Charleston.
Wisconsin	John M. True	Madison.
Wyoming	C. T. Johnston, State Engineer	Cheyenne.

[a] Officials of Territories and island dependencies are included. So far as learned Arizona, Mississippi, New Mexico, South Carolina, and Utah have no State official charged with agricultural interests, but letters addressed to the Secretary of State would probably receive attention.

OFFICERS OF LOUISIANA PURCHASE EXPOSITION, ST. LOUIS.

Hon. D. R. Francis, president, St. Louis, Mo.; Walter B. Stevens, secretary, St. Louis, Mo.; Col. J. H. Brigham, chairman Government board and representative of Department of Agriculture, Washington, D. C.; Harry H. Brigham, assistant representative, Department of Agriculture exhibits, Washington, D. C.; F. J. V. Skiff, director of exhibits, St. Louis, Mo.; F. W. Taylor, chief, departments of agriculture and horticulture, St. Louis, Mo.; F. D. Coburn, chief, department of live stock, St. Louis, Mo.

NATIONAL DAIRY ASSOCIATIONS.

Name of organization.	Secretary.	Post-office.
National Association of State Dairy and Food Departments.	R. M. Allen	Lexington, Ky.
National Dairy Union	Charles Y. Knight	154 Lake st., Chicago.
National Creamery Buttermakers' Association	E. Sudendorf	St. Louis, Mo.
New England Milk Producers' Union	W. A. Hunter	10 Florence st., Worcester, Mass.
Five States Milk Producers' Association	H. T. Coon	Homer, N. Y.

NATIONAL LIVE STOCK ASSOCIATION.

President, F. J. Hagenbarth, Salt Lake City; secretary, Charles F. Martin, Denver.

AMERICAN ASSOCIATION OF LIVE STOCK HERD BOOK SECRETARIES.

President, C. R. Thomas, Independence, Mo.; secretary, Charles F. Mills, Springfield, Ill.

PROTECTION AGAINST CONTAGION FROM FOREIGN CATTLE.

An act of Congress of August 28, 1894, prohibits the importation of cattle and cattle hides, but by the act of March 2, 1895, making appropriations for the Department of Agriculture, it is provided that the prohibition may be suspended by the President whenever the Secretary of Agriculture shall certify to the President what countries or parts of countries are free from contagious or infectious diseases of domestic animals. The President, by proclamation of November 8, 1895, lifted the embargo with reference to Norway, Sweden, Holland, Great Britain, Ireland, the Channel Islands, and the countries of North, Central, and South America so as to admit cattle under sanitary regulations prescribed by the Secretary of Agriculture; also from all countries so as to admit hides under regulations prescribed by the Secretary of the Treasury.

STOCK BREEDERS' ASSOCIATIONS.[a]

Associations of breeders of cattle.

Name of organization.	Secretary.	Post-office.
American Aberdeen-Angus Breeders' Association.	Thomas McFarlane	Union Stock Yards, Chicago, Ill.
American Devon Cattle Club	L. P. Sisson	Newark, Ohio.
American Galloway Breeders' Association	Chas. Gray	Union Stock Yards, Chicago, Ill.
American Guernsey Cattle Club	William H. Caldwell	Peterboro, N. H.
American Hereford Cattle Breeders' Association.	C. R. Thomas	Live-Stock Exchange, Kansas City, Mo.
American Jersey Cattle Club	J. J. Hemingway	8 W. 17th st., New York, N. Y.
American Polled Durham Breeders' Association.	Fletcher S. Hines	Malottpark, Ind.
American Shorthorn Breeders' Association	John W. Groves	Union Stock Yards, Chicago, Ill.
American Sussex Association	Overton Lea	Nashville, Tenn.
Ayrshire Breeders' Association	C. M. Winslow	Brandon, Vt.
Brown Swiss Cattle Breeders' Association	N. S. Fish	Groton, Conn.
Dutch Belted Cattle Association	H. B. Richards	Easton, Pa.
Holstein-Friesian Association of America	Frederick L. Houghton.	Brattleboro, Vt.
Red Polled Cattle Club of America (incorporated).	J. McLain Smith	Dayton, Ohio.

[a] Under the provisions of paragraph 473 of the act of July 24, 1897, amended March 3, 1903, any animal imported specially for breeding purposes shall be admitted free, provided that no such animal shall be admitted free unless pure bred, of a recognized breed, and duly registered in the book of record established for that breed. The Secretary of the Treasury, upon the advice of the Secretary of Agriculture, issued, April 24, 1903, regulations for the importation of animals under this law, and designated the recognized breeds and the books of record established for these breeds.

Associations of breeders of horses.

Name of organization.	Secretary.	Post-office.
American Association of Importers and Breeders of Belgian Draft Horses.	J. D. Conner, jr	Wabash, Ind.
American Breeders' Association of Jacks and Jennets.	J. W. Jones	Columbia, Tenn.
American Cleveland Bay Breeders' Asssociation.	R. P. Stericker	Attica, N. Y.
American Clydesdale Association	R. B. Ogilvie	Union Stock Yards, Chicago, Ill.
American Hackney Horse Society	A. H. Godfrey	Room 50, Astor Court Building, W. 34th st., New York City.
American Percheron Horse Breeders' and Importers' Association.	Geo. W. Stubblefield	Union Stock Yards, Chicago, Ill.
American Saddle Horse Breeders' Association	I. B. Nall	Louisville, Ky.
American Shetland Pony Club	Mortimer Levering	Lafayette, Ind.
American Shire Horse Breeders' Association	Charles Burgess	Wenona, Ill.
American Stud Book, Thoroughbred	James E. Wheeler[a]	173 5th ave., New York City.
American Suffolk Punch Horse Association	Alex. Galbraith	Janesville, Wis.
American Trotting Registry Association	Wm. H. Knight	Ellsworth Building, 355 Dearborn st., Chicago, Ill.
French Coach Horse Society of America	S. D. Thompson	Tacoma Bldg., Chicago, Ill.
German, Hanoverian, and Oldenburg Coach Horse Association of America.	J. Crouch	Lafayette, Ind.
National French Draft Association	C. E. Stubbs	Fairfield, Iowa.
Select Clydesdale Horse Society of America	E. Bennett, jr	Topeka, Kans.
The American Morgan Register	Joseph Battell[b]	Middlebury, Vt.
The Oldenburg Coach Horse Association of America.	C. E. Stubbs	Fairfield, Iowa.
The Percheron Registry Company	Charles C. Glenn	Columbus, Ohio.

[a] Registrar. [b] Treasurer.

Associations of breeders of sheep.

Name of organization.	Secretary.	Post-office.
American Cotswold Association	F. W. Harding	Waukesha, Wis.
American Leicester Breeders' Association	A. J. Temple	Cameron, Ill.
American Lincoln Breeders' Association	do	Do.
American Oxford-Down Record Association	W. A. Shafor	Hamilton, Ohio.
American Southdown Breeders' Association	Frank S. Springer	Springfield, Ill.
American Shropshire Registry Association	Mortimer Levering	Lafayette, Ind.
American Rambouillet Sheep Breeders' Association.	Dwight Lincoln	Milford Center, Ohio.
American Suffolk Association	Geo. A. Franklin	Des Moines, Iowa.
Black Top Spanish Merino Sheep Breeders' Publishing Association.	R. P. Berry	R. F. D. 4, Washington, Pa.
Dickinson Merino Sheep Record Company	H. G. McDowell	Canton, Ohio.
Dorset Horn Sheep Breeders' Association of America.	M. A. Cooper	Washington, Pa.
Hampshire-Down Breeders' Association of America.	Comfort A. Tyler	Nottawa, Mich.
Improved Black-top Merino Sheep Breeders' Association.	L. M. Crothers	Crothers, Pa.
Improved Delaine Merino Sheep Breeders' Association.	Geo. A. Henry	Bellefontaine, Ohio.
Michigan Merino Sheep Breeders' Association	E. N. Ball	Hamburg, Mich.
National Cheviot Sheep Society	H. H. Keim	Ladoga, Ind.
National Delaine Merino Sheep Breeders' Association.	J. C. McNary	Houstonville, Pa.
National Merino Sheep Breeders' Association	R. O. Logan	California, Mich.
National Improved Saxony Sheep Breeders' Association.	John G. Clark	R. F. D. 9, Washington, Pa.
National Lincoln Sheep Breeders' Association	Bert Smith	Charlotte, Mich.
New York State American Merino Sheep Breeders' Association.	J. H. Earll	Skaneateles, N. Y.
Ohio Spanish Merino Sheep Breeders' Association.	Wesley Bishop	Troyton, Ohio.
Standard Delaine Spanish Merino Sheep Breeders' Association.	S. M. Cleaver	East Bethlehem, Pa.
Standard American Merino Register Association.	J. P. Ray	Hemlock, N. Y.
The Continental Dorset Club	J. E. Wing	Mechanicsburg, Ohio.
United States Merino Sheep Breeders' Registry Association.	J. A. B. Walker	Mountair, Pa.
Vermont, The, Atwood Merino Sheep Club Register.	George Hammond	Middlebury, Vt.
Vermont Merino Sheep Breeders' Association	C. A. Chapman	Do.

Associations of breeders of hogs.

Name of organization.	Secretary.	Post-office.
American Berkshire Association	Frank S. Springer	512 E. Monroe street, Springfield, Ill.
American Chester White Record Association	Ernest Freigau	Dayton, Ohio.
American Duroc Jersey Swine Breeders' Association.	T. B. Pearson	Thorntown, Ind.
American Essex Association	F. M. Srout	McLean, Ill.
American Poland China Record Company	W. M. McFadden	Union Stock Yards, Chicago, Ill.
American Small Yorkshire Club	G. W. Harris	3409 Third ave., New York City.
Cheshire Swine Breeders' Association	Ed. S. Hill	Freeville, N. Y.
Central Poland China Record Association	W. H. Morris	Indianapolis, Ind.
Ohio Improved Chester White Swine Breeders' Association.	C. M. Hiles	Ajax Building, Cleveland, Ohio.
Ohio Poland-China Record Company	A. M. Brown	Dayton, Ohio.
Chester White Record Association	W. H. Morris	Indianapolis, Ind.
Southwestern Poland China Record Association.	H. P. Wilson	Gadsden, Tenn.
Standard Poland-China Record Association	Geo. F. Woodworth	Maryville, Mo.
Victoria Swine Breeders' Association	H. Davis	Dyer, Ind.
National Duroc Jersey Record Association	R. J. Evans	El Paso, Ill.
The American Tamworth Swine Record Association.	E. N. Ball	Hamburg, Mich.
The American Yorkshire Club	Harry Krun	White Bear, Minn.

Associations of breeders of dogs, etc.

Name of organization.	Secretary.	Post-office.
American Kennel Club	A. P. Vredenburgh	55 Liberty street, New York City.
United States Official Registry Association	Mrs. S. H. Bond	310 First street SE., Washington, D. C.

STATE SANITARY OFFICERS HAVING CHARGE OF LIVE STOCK MATTERS.

State.	Name and post-office.	Official position.
Alabama	C. A. Cary, Auburn	Professor of veterinary science.
Arizona	H. Harrison, Phoenix	Secretary live stock sanitary commission.
	J. C. Norton, Phoenix	Veterinarian.
Arkansas	R. R. Dinwiddie, Fayetteville	State veterinarian.
California	Chas. H. Blemer, Sacramento	Do.
Colorado	L. B. Sylvester, Denver	President State board of stock inspection.
	Charles D. Lamb, Denver	State veterinary surgeon.
Connecticut	Heman O. Averill, Hartford	Commissioner for domestic animals.
Delaware	Alex. Lowber, Wilmington	Secretary State board of health.
	H. P. Eves, Newark	Instructor in veterinary science, Delaware College.
Florida	Chas. F. Dawson, Lake City	State veterinarian.
Georgia	O. B. Stevens, Atlanta	Commissioner of agriculture.
Idaho	J. C. Dressler, Boise City	State sheep inspector.
Illinois	Chas. E. Miller, Springfield	Secretary board of live stock commissioners.
	C. P. Lovejoy, Princeton	State veterinarian.
Indiana	A. W. Bitting, Lafayette	Do.
Iowa	Paul O. Koto, Forest City	Do.
Kansas	N. S. Mayo, Manhattan	Professor of veterinary science.
	F. H. Chamberlain, Sedan	Secretary live stock sanitary commission.
Kentucky	J. N. McCormack, Bowling Green	Secretary State board of health.
	F. T. Eisenman, Louisville	State veterinarian.
Louisiana	W. H. Dalrymple, Baton Rouge	Veterinarian State experiment station.
Maine	F. O. Beal, Bangor	State cattle commissioner.
Maryland	H. A. Meisner, Baltimore	Chief veterinary inspector.
	Wade H. D. Warfield, Baltimore	Secretary live stock sanitary board.
Massachusetts	Austin Peters, Boston	Chief of the cattle bureau of State board of agriculture.
Michigan	F. C. Wells, Saline	State veterinarian.
	H. H. Hinds, Stanton	President State live stock sanitary commission.
Minnesota	M. H. Reynolds, St. Anthony Park	Veterinarian live stock sanitary board.
	H. M. Bracken, St. Paul	Secretary State board of health.
Mississippi	J. C. Robert, Agricultural College	Professor of veterinary science.

State sanitary officers having charge of live stock matters—Continued.

State.	Name and post-office.	Official position.
Missouri	D. F. Luckey, Columbia	State veterinarian.
	Geo. B. Ellis, Columbia	Secretary State board of agriculture.
Montana	G. W. Preuitt, Helena	Secretary live stock commission.
	M. E. Knowles, Helena	State veterinarian.
Nebraska	W. A. Thomas, Lincoln	State veterinarian.
Nevada	W. H. Patterson, Reno	Secretary State board of health.
New Hampshire	Irving A. Watson, Concord	Secretary State board of health.
	N. J. Bachelder, Concord	Secretary board of cattle commissioners.
New Jersey	Henry Mitchell, Trenton	Secretary State board of health.
	Franklin Dye, Trenton	Secretary tuberculosis commission.
New Mexico	J. A. La Rue, Las Vegas	Secretary cattle sanitary board.
	Harry F. Lee, Albuquerque	Secretary sheep sanitary board.
New York	C. A. Wieting, Cobleskill	Commissioner department of agriculture.
	W. H. Kelly, Albany	Chief veterinarian.
North Carolina	Tait Butler, Raleigh	State veterinarian.
	S. L. Patterson, Raleigh	Commissioner of agriculture.
North Dakota	L. Van Es, Fargo	Chief State veterinarian.
Ohio	W. W. Miller, Columbus	Secretary State board of agriculture.
	Paul Fischer, Columbus	State veterinarian.
Oklahoma	Thomas Morris, Guthrie	Secretary live stock sanitary commission.
Oregon	Wm. McLean, Portland	State veterinarian.
Pennsylvania	Leonard Pearson, Philadelphia	Do.
Rhode Island	Geo. A. Stockwell, Providence	Secretary State board of agriculture.
	John S. Pollard, Providence	Veterinarian, State board of agriculture.
South Carolina	G. E. Nesom, Clemson College	State veterinarian.
South Dakota	J. P. Foster, Huron	State veterinary surgeon.
Tennessee	R. H. Kittrell, Murfreesboro	State live stock commissioner.
	J. W. Scheibler, Memphis	State veterinarian.
Texas	M. M. Hawkins, Quanah	Live stock sanitary commissioner.
Utah	T. B. Beatty, Salt Lake City	Secretary State board of health.
Vermont	Victor I. Spear, Randolph	Secretary cattle commission.
Virginia	J. G. Ferneyhough, Blacksburg	State veterinarian.
Washington	S. B. Nelson, Pullman	Do.
West Virginia	J. O. Thompson, Charleston	Secretary board of agriculture.
Wisconsin	Evan D. Roberts, Janesville	State veterinarian.
Wyoming	Geo. T. Seabury, Cheyenne	Do.
	E. P. Snow, Cheyenne	State board of sheep commissioners.

FORESTRY ASSOCIATIONS.

American Forestry Association.—President, Hon. James Wilson, Secretary of Agriculture; secretary (corresponding), Edward A. Bowers, New Haven, Conn.

International Society of Arboriculture.—President, Gen. William J. Palmer, Colorado Springs, Colo.; secretary, J. P. Brown, Connersville, Ind.

Society of American Foresters.—President, Gifford Pinchot, Washington, D. C.; secretary, George B. Sudworth, Washington, D. C.

SCHOOLS OF FORESTRY.

Yale Forest School, Yale University, New Haven, Conn. A two-years' graduate course, leading to the degree of Master of Forestry. Under the direction of the officers of the Yale Forest School, a two-months' summer course, July and August, is conducted at Milford, Pike County, Pa. Prof. Henry S. Graves, Director.

Biltmore Forest School, Biltmore, N. C. An undergraduate course, covering one year, without vacation. Dr. C. A. Schenck, Director.

University of Michigan Forest School, part of the general Department of Literature, Science, and the Arts, Ann Arbor, Mich. A two-years' graduate course, leading to the degree of Master of Science in Forestry. Filibert Roth, Professor of Forestry.

Harvard University Forest School, Cambridge, Mass. A four-years' undergraduate course, in connection with the Lawrence Scientific School. R. T. Fisher, in charge of curriculum.

NATIONAL GOOD ROADS ASSOCIATION.

President, W. H. Moore; secretary, R. W. Richardson; treasurer, C. H. Huttig. General office, Laclede Building, St. Louis, Mo.

NATIONAL BEE KEEPERS' ASSOCIATION.

President, J. U. Harris, Grand Junction, Colo.; secretary, G. W. Brodbeck, Los Angeles, Cal.; general manager and treasurer, N. E. France, Platteville, Wis.

NATIONAL ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

President, M. V. Slingerland, Ithaca, N. Y.; secretary, A. F. Burgess, Columbus, Ohio.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS OF THE UNITED STATES.

President, M. E. Jaffa, Berkeley, Cal.; secretary, H. W. Wiley, Chemist, Department of Agriculture, Washington, D. C.

NATIONAL HORTICULTURAL AND KINDRED SOCIETIES.

Name of organization.	Secretary.	Post-office.
American Apple Growers' Congress	T. C. Wilson	Hannibal, Mo.
American Association of Nurserymen	George C. Seager	Rochester, N. Y.
American Carnation Society	Albert M. Herr	Lancaster, Pa.
American Cranberry Growers' Association	A. J. Rider	Hammonton, N. J.
American Fruit Growers' Association	John C. Mangan	Bridge, Minn.
American Nurserymen's Protective Association	Thos. B. Meehan	Dreshertown, Pa.
American Pomological Society	John Craig	Ithaca, N. Y.
American Retail Nurserymen's Protective Association.	Guy A. Bryant	Princeton, Ill.
American Rose Society	Leonard Barron	136 Liberty st., New York.
Chrysanthemum Society of America	Fred H. Lemon	Richmond, Ind.
Cider and Cider-Vinegar Association of the Northwest.	George Miltenberger	213 North Second st., St. Louis, Mo.
Eastern Nurserymen's Association	William Pitkin	Rochester, N. Y.
Farmers' Club of American Institute, Horticultural Section.	Leonard Barron	136 Liberty st., New York.
International Apple Shippers' Association	A. Warren Patch	17 North Market st., Boston, Mass.
Mississippi Valley Apple Growers' Association	James Handly	Quincy, Ill.
Missouri Valley Horticultural Society	Harriet E. Chandler	R. R. No. 1, Argentine, Kans.
National League of Commission Merchants	A. Warren Patch	17 North Market st Boston, Mass.
Northwest Fruit Growers' Association	Charles J. Sinsel	Boise, Idaho.
Nurserymen's Mutual Protective Association	Geo. C. Seager	Rochester, N. Y.
Pacific Coast Association of Nurserymen	C. A. Tonneson	Tacoma, Wash.
Peninsula Horticultural Society	Wesley Webb	Dover, Del.
Society of American Florists and Ornamental Horticulturists.	William J. Stewart	79 Milk st., Boston, Mass.
Southern Nurserymen's Association	J. C. Hale	Winchester, Tenn.
Southwestern Nurserymen's Association	J. A. Taylor	Wynnewood, Ind. T.
Western Association of Wholesale Nurserymen	E. J. Holman	Leavenworth, Kans.

ORGANIZATIONS FOR PROTECTION OF BIRDS AND GAME.

Name of organization.	Secretary.	Post-office.
American Ornithologists' Union—Committee on Protection of North American Birds.	William Dutcher, chairman.	525 Manhattan avenue, New York, N. Y.
Audubon Societies—National Committee	William Dutcher, chairman.	Do.
Bird Protective Society of America	Edward C. Pease	28 Stafford Building, Buffalo, N. Y.
Boone and Crockett Club	Madison Grant	11 Wall st., New York, N. Y.
International Forest, Fish, and Game Association.	Frank J. Howell	184 Linden Park boulevard, Chicago, Ill.
League of American Sportsmen	Arthur F. Rice	155 Pennington avenue, Passaic, N. J.
National Game, Bird, and Fish Protective Association.	Charles E. Brewster	Grand Rapids, Mich.
National Association of Game and Fish Wardens.	Charles E. Brewster	Do.
New York Zoological Society	Madison Grant	11 Wall st., New York, N. Y.
North American Fish and Game Protective Association.	E. T. D. Chambers	Quebec, Canada.

FARMERS' NATIONAL CONGRESS.

President, Harvie Jordan, Monticello, Ga.; first vice-president, B. Cameron, Stagville, N. C.; second vice-president, Joshua Strange, Marion, Ind.; treasurer, J. H. Reynolds, Adrian, Mich.; secretary, John M. Stahl, 4328 Langley avenue, Chicago, Ill.; first assistant secretary, George M. Whittaker, Boston, Mass.; second assistant secretary, A. C. Fuller, Dows, Iowa; third assistant secretary, Luther H. Tucker, Albany, N. Y.; executive committee, W. M. Ames, Oregon, Wis.; E. W. Wickey, Ocean Springs, Miss.; Levi Morrison, Greenville, Pa.

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REVIEW OF WEATHER AND CROP CONDITIONS, SEASON OF 1903.

By James Berry, *Chief, Climate and Crop Division, Weather Bureau.*

The accompanying illustrations and tables (see figures 50–52 and plates LXIII–LXV, pages 543 to 549) show how the temperature and rainfall over the United States during the crop season of 1903, from week to week, compare with normal conditions of corresponding periods of former years. The diagrams exhibit the departures from normal, by districts, and the maps show respectively the departures from normal temperature, the total precipitation, and departures from normal precipitation during the crop season.

JANUARY.

January, 1903, averaged slightly colder than usual over portions of the lower Lake region, upper Ohio Valley, and interior of the Middle Atlantic States, generally throughout the South Atlantic States, and along the Gulf coast excepting southern Florida, and in northern California. The temperature averaged nearly normal in the lower Lake region, New England, the Middle Atlantic States, lower Ohio Valley, and southern Florida, and over the northern portion of the west Gulf States. Throughout the remainder of the country the month was milder than usual, being exceptionally mild from the upper Mississippi Valley westward to the north Pacific coast, the greatest excess occurring in Montana, where the excess ranged from 13° to 22° per day. Over the middle Rocky Mountain slope and generally throughout the valleys of the Missouri and Red River of the North it ranged from 6° to 10°.

There was more than the average precipitation over the greater part of the Middle Atlantic States, in portions of the lower Lake region and New England, in Florida, along the Gulf coast, in western Texas, and over an area embracing portions of the middle Plateau and north Pacific coast regions. Over much the greater part of the country the precipitation was lighter than usual, the deficiency being very decided in the central valleys and South Atlantic States and over the western portion of the upper Lake region.

SNOW AND WINTER WHEAT.

The northern portions of the country to the eastward of the central and upper portions of the Missouri Valley were covered with snow until near the end of the month, when the snow melted rapidly, leaving no considerable depths except over the northern portions of the Lake region and New England and in the Red River of the North and upper Missouri valleys. On the whole, the winter wheat crop fared well, the central and northern portions of the winter wheat belt being well protected by snow covering until the closing days of the month, when much snow melted, leaving only the extreme northern districts with a covering on January 31. Over the southern portion of the winter-wheat belt some damage resulted from alternate freezing and thawing, but the crop apparently sustained no serious injury. The rainfall throughout the belt was lighter than usual, but Kansas was the only State that reported need of moisture.

In Washington and Oregon the general condition of wheat was satisfactory, although portions of these States suffered from alternate freezing and thawing. In California the first half of the month in the northern sections was cold and foggy, while hot, dry winds prevailed in the southern part of the State, but no serious damage resulted; more favorable temperature conditions, with beneficial rains, prevailed during the latter part of the month.

FEBRUARY.

February averaged slightly milder than usual in the Atlantic coast districts, over the greater part of the Lake region, and in the valley of the Red River of the North, and nearly normal temperature conditions prevailed in Montana and on the north

Pacific coast. Throughout much the greater part of the country the month averaged cold, the deficiency in temperature ranging from 3° to 15° per day over nearly the entire area west of the Mississippi.

The precipitation was greatly in excess of the average throughout the Southern States, over a large part of the Lake region, central valleys, Middle Atlantic States, and New England, over the southeastern Rocky Mountain slope, and in the eastern portions of the southern Plateau region. In the central and west Gulf States, Ohio Valley, and interior portions of the South Atlantic States the total precipitation amounted to more than 6 inches, portions of the central Gulf States and eastern Tennessee receiving from 8 to 15 inches, the heaviest occurring in the central portions of Mississippi and Alabama. Over the northern portions of the upper Lake region, the valleys of the upper Mississippi, upper Missouri, and Red River of the North, the northern Plateau region, and generally throughout the Pacific coast districts the precipitation was lighter than usual, the deficiency being most marked in the Pacific coast States, less than half the average being reported from northern California, Oregon, and Washington.

At the close of the month there was little or no snow on the ground from the Mississippi eastward, except over the northern portions of the Lake region and New England, but the Red River of the North and upper Missouri valleys and middle Rocky Mountain slope were covered to depths ranging from 2 to 12 inches.

PROGRESS OF FARM WORK—CONDITION OF WHEAT.

With excessive precipitation and low average temperature in the Southern States the month was not favorable for farming operations in that section, but with lighter precipitation and only slightly deficient temperature the Ohio and upper Mississippi valleys experienced more favorable conditions. In California the first part of the month was abnormally cold, but the latter part was more favorable. Winter wheat was well protected with snow covering during the severe weather of the 15th to 19th, and the reports at the close of the month indicated that the crop was in very satisfactory condition. In portions of Missouri, Illinois, Indiana, and Kentucky, however, the crop sustained some injury from alternate freezing and thawing, while lowlands suffered to some extent from overflows in the lower Ohio Valley.

MARCH.

From the Atlantic coast westward to the eastern Rocky Mountain slope the month of March, 1903, was warmer than the average, the temperature excess ranging from 2° to 6° per day in the Southern States and the Mississippi and Missouri valleys, and from 6° to 12° in the Ohio Valley, Lake region, Middle Atlantic States, and New England. There was also a slight excess in temperature over extreme southern California and in southern Idaho. The month was colder than usual in western Texas and generally throughout the Rocky Mountain region and Pacific coast States, the temperature deficiency being greatest in Montana, where it ranged from 2° to 6° per day.

The precipitation was in excess of the average from New England southwestward to the east Gulf coast, in Louisiana and the eastern half of Texas, and in Wisconsin, Minnesota, and eastern South Dakota. The amounts of precipitation ranged from 4 to 6 inches in New England and the Middle Atlantic States, and in the Gulf States from about 5 inches in the eastern portion to over 20 inches in portions of Louisiana. In the Lake region and Ohio Valley the precipitation ranged from about 2 to over 4 inches. There was an excess in the Puget Sound region and generally throughout California, where the precipitation ranged from 4 to 7 inches. Less than the usual amount fell in portions of the South Atlantic States, Lake region, and Ohio and lower Mississippi valleys, and generally throughout the eastern Rocky Mountain slope.

SPRING SEEDING AND GROWTH—FLOODS IN THE LOWER MISSISSIPPI VALLEY.

March weather conditions were generally favorable for the growth of grain and grasses in all districts east of the Rocky Mountains, but outside of New England and portions of the Middle Atlantic States and Lake region spring work was retarded by excessive rains and wet soil. While the season at the close of the month was two to four weeks in advance in New England and portions of the Middle Atlantic States, it was correspondingly late in other sections. Much valuable land was inundated in the lower Mississippi Valley. On the Pacific coast the weather conditions were generally favorable, although too cool, the season being two to three weeks late in Washington.

Reports from all sections indicated that winter wheat was in very promising condition generally. The crop wintered well and was making vigorous growth in all sections. Too rank growth, however, was reported from limited areas in Kentucky, and some damage by water on lowlands in Maryland and the lower Ohio and central Mississippi valleys. In California winter wheat was in excellent condition. Some spring wheat was sown in Washington, but no seeding was done in the principal spring-wheat States, the soil being too wet for preparatory work.

The seeding of spring oats was begun as far north as Michigan, but this work was retarded to a considerable extent by wet ground. Fall-sown oats made vigorous growth in the Southern States with excellent prospects, although seriously damaged by lice in some portions of South Carolina. Very little corn had been planted north of the Gulf States.

Cotton planting was in progress in Texas, southern Georgia, and eastern South Carolina; a little had been planted in Alabama and Florida, and preparations for this work in Louisiana and Mississippi were general, except in the flooded districts.

The Crop Season, April–September, Summary by Weeks.

By weeks, ending with Monday, from April 13 to October 5, the crop conditions may be summarized as follows:

April 13.—In the districts east of the Rocky Mountains the temperature was highly favorable for the growth of vegetation, but farm work was very generally retarded by rains in the Lake region, central valleys, and Atlantic-coast districts, while insufficient moisture was unfavorable in portions of the central and west Gulf States. In the central and northern Rocky Mountain districts and on the north Pacific coast the season was very backward, and Washington and Oregon suffered from cold, wet weather. In California the conditions were generally favorable, with the exception of some damage by frost.

Corn planting was in progress as far north as Kansas, southern Missouri, Tennessee, and North Carolina, and farther south planting was well advanced, being completed in some sections.

The condition of winter wheat was generally excellent. In the Ohio Valley, however, the freeze of the 4th and 5th caused some injury. On the whole, the condition of the crop in the winter-wheat belt east of the Rocky Mountains was more promising than for years. In California the outlook was also promising, but in Oregon and Washington the condition was less favorable, especially in the last-named State. Spring-wheat seeding was nearly completed in Iowa and Nebraska, and was progressing well in South Dakota, but none had been sown in North Dakota and in northern Minnesota.

Cotton planting made good progress in the central and western portions of the cotton belt, except in the flooded areas of Mississippi and Louisiana. Planting was well advanced in southern Georgia, but progressed slowly in northern Georgia and in South Carolina.

FRUIT PROSPECTS IMPAIRED BY FREEZING TEMPERATURES.

By the close of March, which was a very mild month over the eastern half of the country, all fruit trees were unusually far advanced. From the 4th to the 6th of April the whole country east of the Mississippi River, including Tennessee and the northern portion of the South Atlantic States, experienced temperatures below freezing, stations in the more northerly districts reporting temperatures from 6° to 18° below freezing, and many varieties of fruit suffered severely, more particularly peaches.

April 20.—In the States of the upper Missouri Valley this week was milder than usual and generally favorable for farming operations; but elsewhere east of the Rocky Mountains the temperature was much below the average, and excessive rains retarded farm work generally throughout the Atlantic coast districts, Ohio Valley, and the southern portion of the Lake region. The central and west Gulf States and portions of the southeastern Rocky Mountain slope were much in need of rain, no appreciable amount having fallen over a large part of these districts for more than two weeks. On the Pacific coast cool weather retarded growth, and frosts caused considerable injury in Oregon. Southern California coast districts received heavy rains.

Very slow progress was made with corn planting throughout the corn belt and in the Middle and South Atlantic States, owing to cold, wet weather, while dry weather impaired stands in the central and west Gulf States.

The previously reported excellent condition of winter wheat in the principal winter-wheat States continued unimpaired, except to a slight extent in portions of the upper Ohio Valley, where in some localities it was turning yellow. Less favorable reports were also received from the Middle and South Atlantic States and portions of Texas. Seeding of spring wheat was general in all parts of the spring-wheat region, but progress was not rapid in southeastern Minnesota, owing to wet soil. Early sown wheat in Iowa and South Dakota germinated slowly, though even stands were indicated. On the north Pacific coast spring-wheat seeding was much delayed.

Rains in portions of the eastern districts and dry weather in the central and western portions of the cotton belt interfered with cotton planting to some extent; this work, however, was vigorously pushed and made fair progress.

Tobacco plants were plentiful and generally well grown, except in Kentucky, where they were late.

Although frosts of the 18th caused further injury to fruit in the upper Ohio Valley, the reports, generally, excepting those respecting peaches, were somewhat more encouraging than those of the previous week.

LOW TEMPERATURES, DROUGHT, AND FURTHER DAMAGE TO FRUIT.

April 27.—Nearly the whole of the country east of the Rocky Mountains experienced unseasonably low temperatures during this week, and while the rainfall in the central valleys was light, considerable areas receiving no appreciable amount, farm work made very slow progress in consequence of wet soil and low temperatures. The drought in Florida and in the central and west Gulf States, especially in the last-mentioned sections, became more serious, and over large areas the ground was too dry for germination of seed. More favorable conditions prevailed in the States of the upper Missouri Valley, and, while absence of rain in New England and the northern portion of the Middle Atlantic States permitted farm work, the weather was too cool for growth of vegetation. In the Rocky Mountains and Pacific coast districts the week was the most favorable of the season, although portions of California needed rain.

As in the previous week, corn planting progressed slowly, more particularly over the central and eastern portions of the corn belt and in the Middle Atlantic States, but better progress was made in Kansas and Nebraska. Preparations for this work were vigorously carried on in Iowa and portions of Illinois. In the Southern States corn suffered from low temperatures, and in the central and west Gulf districts from drought also.

While the condition of winter wheat continued very promising, a slight deterioration was indicated over the central and eastern portions of the wheat belt. Rust and insects appeared in some counties in southern Missouri, and in Nebraska and portions of Kansas the crop needed rain. On the Pacific coast the outlook continued favorable, except in Washington, where much was winter-killed.

In the Missouri and central Mississippi valleys oats seeding was well advanced, but in the Ohio Valley much seeding remained to be done. Germination of the early sown in Michigan, Wisconsin, and Illinois was unsatisfactory.

East of the Mississippi River early cotton was injured by cold and much replanting was made necessary. Planting in this part of the cotton belt progressed rapidly, except in Mississippi, where, as in the districts west of the Mississippi, planting, although well advanced, was largely suspended on account of drought. Warmth was generally needed throughout the cotton belt, and the central and western districts were in urgent need of rain.

This week was very unfavorable to fruit in the States east of the Mississippi River, frosts being general on the 23d and 24th as far south as the northern portion of the central and eastern Gulf States, with more or less damage to earlier varieties.

ABNORMALLY COOL—INJURY TO EARLY PLANTED CORN AND COTTON.

May 4.—This week was unseasonably cool over much the greater part of the country, the minimum temperatures on April 30 and May 1 and 2 being the lowest recorded in the last ten days of April and the first ten days of May for the past thirty years at nearly all Weather Bureau stations from the central and west Gulf coasts to the upper Missouri Valley, and also at a number of stations in the central Mississippi and Ohio valleys, Lake region, and New England. Generally light rainfall, or absence of rain, was favorable for farming operations, but the unseasonably low temperatures checked the growth of all vegetation, and heavy frosts and freezes caused much damage.

Drought was relieved over southeastern Texas and over limited areas in the central Gulf States, but continued over the greater part of the last-mentioned districts and in northern Texas.

The early planted corn was extensively killed by the freeze during the latter part of the week in Missouri, Kansas, Oklahoma, and Texas, and the crop suffered from cold weather throughout the Southern States. Preparations for planting progressed favorably in the Ohio Valley and Middle Atlantic States, but in the States of the upper Missouri Valley and Lake region little progress was made.

Winter wheat appeared to have escaped material injury during the recent freeze over the western portion of the winter-wheat belt and the general outlook for this crop continued very promising; a slight deterioration was indicated in portions of the central Mississippi and Ohio valleys.

Oats sustained more or less injury from cold in the States of the Missouri Valley, and slow growth was generally reported in the central Mississippi and Ohio valleys.

Early planted cotton on lowlands in northern Texas and Oklahoma was killed by the freeze of April 30 and May 1, and throughout the cotton belt low temperatures proved seriously detrimental in retarding germination and growth, while drought continued in northern Texas and in the central Gulf States. Poor stands were very generally reported. In the eastern districts planting was vigorously pushed and was nearing completion.

Nearly all fruits suffered further damage from frosts and low temperatures, apples having apparently escaped with the least injury. The grass crop was very backward.

May 11.—The Ohio Valley, Middle Atlantic, and Southern States experienced another cool week, and while the temperature was above the seasonal average in the more northerly districts, the reports generally indicated the need of warmth. In the lower Missouri, central Mississippi, and Ohio valleys, Atlantic coast districts, east Gulf States, and Rocky Mountain and Pacific coast districts, rain was needed. Much-needed and abundant rains fell in the west Gulf States and Florida. In Oklahoma, Kansas, Nebraska, Iowa, the Dakotas, Minnesota, and Wisconsin the conditions were generally favorable.

Corn planting continued very late, but was in general progress throughout the central valleys, and had begun in the extreme northern districts. This work was carried on under much difficulty in the lower Missouri, central Mississippi, and Ohio valleys, and portions of the Middle Atlantic States, owing to hard and cloddy ground. Germination and growth were very slow in all districts; in the west Gulf States, however, corn recovered rapidly from the effects of the cold of the previous week.

An improvement in the condition of winter wheat was reported from Nebraska, Kansas, Oklahoma, Texas, and Ohio, but the crop suffered deterioration in Indiana, Illinois, Kentucky, and Missouri, much in the southern portion of the last-mentioned State having been greatly damaged by rust and insects. Wheat was heading as far north as Kentucky and southern Missouri. On the Pacific coast winter wheat continued thrifty in Oregon, but in Washington and California it needed rain, the late sown in California being very unpromising. Spring-wheat seeding was practically finished, and the early sown was coming up to good stands and was in healthy condition, having apparently escaped damage from the severe weather of the previous week. In the northern Rocky Mountain districts and in Washington the reports were less favorable, owing to lack of rain.

The seeding of oats was nearly finished in the more northerly districts, where good stands were promised, and from Texas northward to the upper Missouri Valley the crop had improved much; but from the lower Missouri Valley eastward over Illinois, Indiana, and Ohio, the stands were uneven and the crop was much in need of rain.

Although much too cool, nearly the whole of the cotton region received abundant rainfall, which was of the greatest benefit in the central and western districts, where germination and growth of cotton progressed satisfactorily. In the Carolinas, northern Georgia, and Tennessee, germination and growth were very slow. Planting was very nearly completed in the northern portion of the belt, but the crop was generally much later than usual.

No tobacco had yet been transplanted north of the Carolinas and Tennessee. Plants continued plentiful.

In the central valleys and Middle Atlantic States grass made very slow growth and was much in need of rain and warmth, but was in more favorable condition in the Lake region and upper Missouri Valley.

May 18.—All northern and central districts east of the Rocky Mountains experienced highly favorable temperatures during this week, the central valleys, Lake region, and New England receiving ample and much needed warmth. In the Southern States, however, it was too cool for favorable growth. The very general absence of rain in New England and the Middle Atlantic States and over a large part of the

Lake region and Ohio Valley intensified drought in these districts, in consequence of which crops made slow progress and planting and germination were greatly hindered. The east Gulf States and portions of the lower Missouri and lower Mississippi valleys suffered from excessive rains. On the Pacific coast the week was rather cool with no rain over the greater part of California. There were generally good rains in Washington, with light showers over a large part of Oregon, but more rain was needed in the last-named State.

Corn planting was further delayed by rains in the States of the lower Missouri Valley and by drought in the Ohio Valley, Middle Atlantic States, and portions of the Lake region. Planting was well advanced in the Dakotas, and, notwithstanding the wet soil in Iowa and Missouri, was vigorously pushed in those States, where it was germinating very satisfactorily. In Nebraska, the Ohio Valley, and Middle Atlantic States a large acreage was yet to be planted, not more than half the area having been seeded in Ohio and Nebraska.

Winter wheat made favorable progress in Nebraska and Kansas, and was improved by rains in portions of Missouri, Oklahoma, Texas, Arkansas, Tennessee and Kentucky, but in southern Missouri and in the States northward of the Ohio River and in the Middle Atlantic States the crop suffered further deterioration. In the spring-wheat region the weather conditions were highly favorable for germination and growth of spring wheat, which was coming up to good stands. In the northern Rocky Mountain States the growth of spring wheat was slow; in Washington and Oregon the outlook was very promising.

In the Missouri Valley, Oklahoma, and Texas there was a general improvement in the condition of oats, but in the Ohio Valley, the Middle Atlantic States, and the greater part of the Lake region drought affected the crop.

There was general complaint throughout the cotton belt of the unfavorable effects of low temperatures on cotton. Good stands, as a rule, were reported in the central districts, but in the eastern and western portions the stands were irregular. The crop was generally late, and warmth and sunshine were much needed.

The grass crop in the Ohio Valley, Lake region, Middle Atlantic States, and New England was much in need of rain, but westward of the Mississippi it made rapid growth and was in promising condition.

BENEFICIAL WARMTH IN EASTERN STATES—LOW TEMPERATURES, FROST, AND SNOW IN EXTREME WEST—UNBROKEN DROUGHT IN NEW ENGLAND.

May 25.—Respecting temperature, this week in the districts east of the Rocky Mountains was the most favorable of the season and the first in which there was no complaint of lack of warmth in some part of this region. Heavy rains from Oklahoma and Arkansas northward to Minnesota and the Dakotas retarded work. Drought was largely relieved in the Ohio Valley, Lake region, and southern portions of the Middle Atlantic States, but continued with greater severity over the northern portion of the last-named district and in New England. In the Rocky Mountain and Pacific coast regions the week was abnormally cool, with heavy frosts and considerable snow in the central and northern districts.

Good progress was made with corn planting in Indiana, Illinois, Michigan, and Wisconsin, but to the westward wet weather prevented the completion of this work, which was much delayed, while drought prevented germination and planting in the Middle Atlantic States and New England. In the Southern States corn made favorable progress.

In the southern portions of Missouri and Kansas winter wheat suffered some deterioration, but elsewhere in these States and in Nebraska the crop continued promising. In Michigan and Wisconsin decided improvement was reported, and in Pennsylvania it withstood the drought better than other crops. Winter wheat was now heading in the more northerly districts. In the Dakotas, Minnesota, Iowa, and Nebraska spring wheat made rapid growth and was in very promising condition. In the north Pacific coast States the crop was backward.

In the States of the Missouri Valley oats made favorable growth and a decided improvement was reported from Michigan and Illinois. In the Ohio Valley and Middle Atlantic States the outlook was less promising. Harvesting was general in southern Texas, Georgia, and Florida.

There was a general improvement in cotton, particularly in the middle and western districts. Portions of Mississippi and northern Texas continued to suffer for rain, and boll-weevils were reported from several counties in southern Texas, where cutworms also caused damage, as well as in some central counties.

Grass greatly improved in the Ohio Valley and Lake region and continued in promising condition in the Mississippi and Missouri valleys, but in the Middle Atlantic States and New England a short crop was promised.

WHEAT HARVEST BEGINS—COTTON IMPROVED—TRANSPLANTING TOBACCO.

June 1.—The States of the lower Missouri Valley and portions of the Mississippi Valley suffered much from heavy rains, especially Iowa, the eastern portions of Kansas and Nebraska, and western Missouri. Drought continued in New England, the northern portion of the Middle Atlantic States, and in Florida, and rains were needed in portions of the central Gulf States and in southern Texas. Drought was wholly relieved in the Ohio Valley and over the greater part of the Middle and South Atlantic States. The latter part of the week was unseasonably cool in the lower Missouri Valley, west Gulf districts, and New England, damaging frosts having occurred in the last-mentioned district. Very favorable temperatures prevailed in the Ohio Valley and South Atlantic and east Gulf States, but more favorable conditions than in the previous week were reported from the Pacific coast States.

Wet weather caused further delay in corn planting in the Missouri and upper Mississippi valleys, where much of this work was unfinished, and the early planted was becoming weedy. In the eastern portion of Kansas and in Nebraska and in Iowa corn fields were badly washed and much replanting made necessary. In Illinois planting was practically finished and an excellent stand attained. In the central and upper Ohio Valley planting was also delayed, and early fields in some portions were suffering for cultivation. In the Southern States corn experienced a very favorable week and was largely laid by.

Winter wheat on low lands in the eastern portions of Kansas and Nebraska and northwestern Missouri sustained injury from floods, but on the whole the crop made satisfactory advance, an improvement being generally indicated in the Ohio Valley, Lake region, and Middle Atlantic States. Harvesting was general in Texas and had begun in Arkansas and North Carolina. Winter wheat made slow growth in Washington and Oregon, and in the eastern portion of Oregon was unusually weedy. In Nebraska, the Dakotas, and northern Minnesota spring wheat made splendid progress, but in southern Minnesota, Wisconsin, and Iowa the crop on low lands suffered much from heavy rains. In Washington and Idaho the crop was greatly improved.

On low lands in the lower Missouri and upper Mississippi valleys oats suffered from heavy rains, but, on the whole, this crop did well.

Further improvement in cotton was generally indicated, but, as a rule, the crop was two to three weeks late. Better stands were reported from the Carolinas, Tennessee, and Alabama, and portions of Mississippi, Louisiana, and Texas.

The week was very favorable for transplanting tobacco, and this work made rapid progress in the Ohio Valley and Middle Atlantic States.

The hay crop continued promising in the Missouri and upper Mississippi valleys, and further improvement was reported from the Ohio Valley and Middle Atlantic States. In the last-named section, however, and in New England, a very light yield was promised.

DAMAGE BY RAIN IN PARTS OF CENTRAL VALLEYS—DROUGHT IN NEW ENGLAND.

June 8.—Excessive rains in the lower Missouri, central Mississippi, and Ohio valleys, Tennessee, the Carolinas, and Georgia interrupted farm work and caused great damage to crops, especially in the central Mississippi and lower Missouri valleys, the flood stage in the Mississippi River at St. Louis being the highest since 1858, and that in the Missouri River at Kansas City since 1844. The protracted and probably unprecedented spring drought continued unbroken in northern New England and in eastern New York. Portions of the upper Lake region, central and west Gulf States, North Dakota, and Montana needed rain. Highly favorable temperature conditions prevailed in the Rocky Mountain States, but on the Pacific coast the week was very hot and dry, especially in California and Oregon, while the early part of the week in the central and west Gulf States was too cool.

Much corn remained to be planted in the Missouri, Mississippi, and Ohio valleys, where early planted corn was greatly in need of cultivation, and much was drowned. Planting was resumed in Nebraska and Iowa during the latter part of the week and in the Middle Atlantic States was finished.

Rust in winter wheat was very generally reported from the Ohio, central Mississippi, and lower Missouri valleys, and in the two districts last named the crop sustained much damage from floods. In the Lake region and Middle Atlantic States and over the northern portion of the Southern States an improvement was generally noted. Harvesting progressed rapidly in Texas and was begun in California, where early wheat promised good yields. In Washington and Oregon winter wheat advanced favorably, but short heads were reported from Oregon and poor stands from portions of Washington. Spring wheat continued in very promising condition in the Dakotas and generally in Minnesota.

Cotton in the eastern portion of the belt made good growth, but was very grassy and was much in need of sunshine, while portions of the central districts needed rain and suffered somewhat from cool nights during the early part of the week. Good showers were very beneficial in Texas, where chopping progressed rapidly. Considerable damage by webworms was reported from northern Texas and by cutworms and boll-weevils in central and southern counties. The crop also sustained damage by insects in Indian Territory and by floods in Missouri and Tennessee.

The week as a whole was very favorable for transplanting tobacco, which was nearly completed over about three-fourths of the tobacco area, having made favorable progress in all districts. Good stands were generally indicated.

The previously reported promising condition of grass in the central valleys continued, and a decided improvement was indicated in the southern portion of the Middle Atlantic States, but in the northern portion of the last-named district and in New England the outlook was very poor.

LONG DROUGHT IN NEW ENGLAND BROKEN—PROGRESS OF CROPS.

June 15.—This week was abnormally cool in nearly all districts east of the Rocky Mountains, the minimum temperatures from the 10th to the 13th throughout the central valleys and Southern States being the lowest of record for the second decade of June, and heavy frosts were of general occurrence in the upper Missouri Valley, with light frosts as far south as Tennessee. Under these conditions the growth of vegetation was slow, but with a very general absence of rain in the central valleys much needed cultivation made favorable progress. The long-continued and disastrous drought in New England and the northern portion of the Middle Atlantic States was wholly relieved, being succeeded in some sections by flood conditions, and the widespread forest fires in these districts were extinguished. Generally favorable conditions prevailed on the Pacific coast, except during the early part of the week in Washington, where drying northerly winds proved injurious in some sections. The week was unseasonably warm in the eastern portions of Oregon and Washington and in Idaho and northern Nevada.

While planting, replanting, and cultivation of corn in the central valleys were pushed vigorously, considerable planting remained unfinished in the northern districts. Corn was unusually late and made very slow growth under the low temperatures. In the Middle and South Atlantic States the crop was much in need of cultivation, and in the Southern States was largely laid by.

Winter wheat harvest was in progress as far north as the southern portions of Kansas, Missouri, Illinois, Indiana, and Virginia. While an improvement in the condition of this crop was indicated in northern Illinois, Ohio, and the northern portion of the Middle Atlantic States, it suffered deterioration over a large part of the winter wheat belt as a result of insects and increasing rust. In California the crop matured rapidly and harvest was in progress in the southern portion. The crop was threatened by hot, drying winds in Washington during the latter part of the week, but escaped with slight injury. Spring wheat generally was in thrifty condition, but needed rain in portions of the Dakotas. Over the southern portion of the spring wheat region the condition of the crop was very promising, and a marked improvement was shown in Oregon, but in Washington it experienced trying conditions, although apparently it was not seriously injured.

Cotton continued very backward, having made slow growth under the abnormally low temperatures. Chopping made favorable progress throughout the belt, but cultivation was not well advanced except in portions of the central districts. Rains were beneficial in Texas, where fair stands of early planted were indicated, but cutworms proved injurious in north central, and boll weevils continued destructive in south central counties.

All reports respecting tobacco indicated that this crop made favorable progress, transplanting being finished, except in the more northerly sections and on some bottom lands in Virginia and Ohio. Frosts injured the crop to some extent in exposed places in Wisconsin.

June 22.—While still too cool in the districts east of the Rocky Mountains, the temperature was somewhat more favorable in the central valleys and Southern States, but over portions of the Lake region and Middle Atlantic States and in New England it was lower than in the preceding week. Heavy rains in the two districts last named interrupted farm work, but in the Ohio and upper Mississippi valleys and Gulf States the conditions were very favorable for cultivation. Rain was needed in the Dakotas, northern Minnesota, and in portions of the central and east Gulf districts. The conditions on the Pacific coast were generally favorable, but in the coast sections of Oregon work was delayed by rain, while rains were needed in the eastern portions of both Oregon and Washington.

There was a general improvement in corn in the central valleys, especially over the western portions, but in the Lake region, New England, and Middle Atlantic States little or no improvement in this crop was noted. In all northern and central districts corn continued very late, but was in good state of cultivation, except in the Middle Atlantic States. In the Southern States early corn was largely laid by, and was nearing maturity in Texas.

Winter wheat harvest progressed favorably and was general in the central portions of the winter wheat belt, with disappointing yields, especially in the southern portions of Missouri, Illinois, and Indiana. In the Middle Atlantic States a general improvement was indicated. Harvest was general in California. In Oregon and Washington some improvement was noted, but the crop was in need of rain in the eastern portions of these States. Spring wheat suffered for rain in North Dakota and portions of South Dakota, and was affected by rust quite generally in Nebraska. In the two States last named, however, the crop, as a rule, did well, and in Minnesota, Wisconsin, and Iowa continued in promising condition. In Washington the crop improved where moisture was sufficient, but in central counties and also in eastern Oregon it was threatened by drought.

The outlook for oats was less promising in the Dakotas, Nebraska, northern Minnesota, Missouri, and southern Illinois, but in Wisconsin and Kansas, on uplands in Iowa, and in northern Illinois a good crop was promised. An improvement was reported from Michigan, the Ohio Valley, and Middle Atlantic States.

Cotton continued small, but its general condition was somewhat improved. Cultivation made good progress, and fields were clean, except in portions of the eastern districts. In Texas plants were healthy and made rapid growth, but the crop was two or three weeks late. Boll weevils were spreading in Texas, but so far had done little injury. Lice caused damage to cotton in the Carolinas, Arkansas, and Missouri.

In New England tobacco needed warmth and sunshine, but elsewhere this crop made favorable progress, except in North Carolina and portions of Virginia, a marked improvement being reported from Pennsylvania and New Jersey. Transplanting was about finished.

Rains caused a marked improvement in grass in New England and the Middle Atlantic States, but a light crop was promised in these districts and also in the upper Ohio Valley. A good crop was being secured in the central valleys.

June 29.—Throughout the central valleys, Lake region, Atlantic coast districts, and the northern portions of the Southern States the week was decidedly cool and the Atlantic coast and east Gulf districts suffered from continuous rains. While too cool for rapid growth, crops advanced favorably in the central valleys, where the general absence of heavy rains was favorable for cultivation and harvesting. Warmth and sunshine were greatly needed in the Atlantic coast and east Gulf districts. Drought conditions in South Dakota were largely relieved, but continued with damaging effects in North Dakota and northern Minnesota. Rain was needed in the central portion of Washington, while work was interrupted by rains in western Oregon; elsewhere on the Pacific coast the conditions were generally favorable.

Further improvement in the condition of corn was generally reported, and while the crop continued late it made good growth over the western portion of the corn belt, the condition of the crop in Iowa at this time closely approximating the average. In the Middle Atlantic States corn made slow growth, was very backward, and much in need of cultivation.

Except over local areas the conditions were very favorable for winter wheat harvest in the central valleys, but this work was interrupted by rains in the Middle Atlantic States. A marked improvement in the condition of winter wheat was reported from New York and Michigan, and the crop was maturing rapidly and in good condition in Nebraska. In North Dakota there was a decided deterioration in the condition of spring wheat as a result of drought, which also proved damaging in portions of South Dakota and northern Minnesota. Generally, however, in South Dakota and on uplands in southern Minnesota the crop was in thrifty condition, and it continued promising in Wisconsin, Iowa, and Nebraska. A decided improvement was reported from Washington and Oregon, except in central Washington, where drought caused injury.

Except in North Dakota and portions of South Dakota, Minnesota, and the upper Ohio Valley, the oats crop advanced very favorably, and harvesting was in progress as far north as southern Missouri.

The condition of cotton was very generally improved throughout the belt, but the crop continued late and was suffering for cultivation in the eastern districts, where low night temperatures checked growth. Lice and rust caused injury in North Carolina and Missouri, and in Texas boll-weevils were spreading and becoming more injurious. The crop also suffered for cultivation in portions of Louisiana and central

and northern Texas. Sunshine and heat were generally needed, especially in the central and eastern districts.

In the tobacco districts the weather conditions were very favorable for this crop, which, however, was in need of cultivation in Maryland.

Harvesting of a fine crop of hay was in progress in the central valleys, and the condition of grasses in the Middle Atlantic States and New England was much improved.

HARVEST OF WINTER WHEAT, OATS, AND HAY—IMPROVEMENT IN CORN AND COTTON.

July 6.—This week was the most favorable of the season to date, giving ample and much needed heat in all districts east of the Rocky Mountains. Drought in the northern portion of the spring wheat region was relieved, but need of rain was beginning to be felt in the Ohio Valley, portions of the central Gulf States, and in western Texas. In the central and northern Rocky Mountain districts and on the north Pacific coast it was too cool, frost, more or less damaging, occurring from the 2d to the 4th in Idaho, Wyoming, and Utah.

Under the very favorable temperature conditions corn advanced rapidly in the central valleys and was greatly improved and generally well cultivated. In the northern portion of the Middle Atlantic States and in the upper Ohio Valley, Lake region, and the Dakotas the crop continued backward, but was improving, though needing cultivation in many parts of these districts. In the Southern States corn was largely laid by, an unusually fine crop being practically assured in the west Gulf districts.

Harvesting of winter wheat progressed under favorable conditions and was nearly completed in portions of the central districts. Thrashing was in general progress, with yields lighter than anticipated in nearly all districts. Winter wheat was ripening on the north Pacific coast, the crop being practically safe in Washington. High winds and excessive heat caused injury in California in some sections, but excellent yields were reported from the southern part of the State. Early spring wheat sustained permanent injury in portions of North Dakota and northern Minnesota from drought, which was broken by abundant rains that were of great benefit to the late crop. In southern Minnesota and parts of South Dakota lodging and rust were reported. In Wisconsin, Iowa, Nebraska, and Kansas, and on the north Pacific coast the crop progressed satisfactorily.

The outlook for oats in Minnesota and South Dakota was improved, and the crop continued generally promising in the States of the Missouri and upper Mississippi valleys. A light crop, however, was indicated in the Ohio Valley and portions of Illinois and southern Missouri.

Cotton made rapid growth throughout the cotton belt, an improvement being shown in all districts, the reports from the Carolinas and Georgia indicating the most decided advance. Wet weather, however, was unfavorable in portions of Louisiana and Texas, where the crop was grassy, being quite foul in northern Texas, in which State boll-weevils were causing considerable damage and continued to increase.

In the most important tobacco States tobacco made fine growth, the condition of the crop being very promising, except in southwestern Ohio, where rain was needed, and in Pennsylvania, where slow growth was reported.

The outlook for apples appeared somewhat more promising in the Ohio Valley and portions of the Middle Atlantic States, and fair to good crops were indicated in Michigan, Tennessee, and Iowa. Poor prospects were reported from Arkansas, Missouri, Illinois, and West Virginia, and in New York the outlook was less favorable.

COMPLETION OF WINTER WHEAT HARVEST IN CENTRAL VALLEYS.

July 13.—The temperature during this week was very favorable in all districts east of the Rocky Mountains and also on the Pacific coast, but in the northern Rocky Mountain and middle Plateau regions it was too cool, with frosts in exposed places on the 7th and 8th. Portions of the lower Ohio and central Mississippi valleys, southern Florida, western Texas, northern Minnesota, and the southern Rocky Mountain districts were in need of rain, but elsewhere there was ample moisture, northern Iowa, southern Minnesota, and portions of the South Atlantic and east Gulf States having suffered from excessive rains.

Corn everywhere made splendid growth and was much improved, though generally backward, and in portions of the upper Ohio Valley and Middle Atlantic States it was weedy. The early planted was in tassel in the more northerly districts, and a considerable part of the crop had received final cultivation.

The week was very favorable for harvesting winter wheat, which work was very largely completed, except in the more northerly sections. Thrashing made good progress, the reports generally indicating light yields. A feature of the reports respecting winter wheat was the entire absence of injury to grain in stack and shock. In northern Minnesota and North Dakota spring wheat was thin and heading short, and lodging was reported from portions of southern Minnesota and South Dakota, while rust was reported from the last-named State and Iowa. In Kansas, Wisconsin, and the southern part of South Dakota spring wheat headed well, and very favorable reports were received from Washington and Oregon.

Considerable rust in oats was reported from Iowa, Missouri, and Illinois, and lodging from South Dakota and southern Minnesota. In North Dakota and northern Minnesota the crop was thin and heading short, but in Nebraska, Wisconsin, Michigan, and Pennsylvania it continued promising. Harvest was in general progress in the central valleys, good yields being reported from Missouri, Nebraska, Kansas, and Oklahoma, but light yields from the States of the Ohio Valley.

Throughout the cotton belt there was a general improvement in cotton, which made vigorous and healthy growth. There was, however, very general complaint of grassy fields in the coast districts of the eastern section and in Texas, the crop being in a better state of cultivation in Mississippi and over the northern portion of the central districts.

The general outlook for tobacco was very promising, the least favorable reports being received from Ohio, where, however, the crop was doing fairly well.

Haying was delayed by rains in Iowa, Wisconsin, and southern Minnesota, but elsewhere this work made excellent progress.

July 20.—While the temperature in the central valleys, Lake region, and Atlantic coast districts averaged considerably below normal, no unfavorable effects from cool weather were apparent, except in portions of the Middle and South Atlantic States, where growth was checked to some extent. The need of rain continued in portions of the lower Ohio and central Mississippi valleys, North Dakota, northern Minnesota, and western Texas, and was beginning to be felt in the central Gulf States, Oklahoma, southwestern Kansas, and portions of the Carolinas. Local storms, in places accompanied by hail, proved damaging in the upper Missouri, upper Mississippi, and Ohio valleys, and Lake region. Conditions on the Pacific coast were favorable, although light frosts caused slight damage in Washington during the early part of the week.

Corn advanced favorably in all districts, but in the principal corn States it was variable as to size and condition, being generally small, especially in the central and eastern districts of the corn belt. As a rule the crop was in a good state of cultivation, except in the upper Ohio Valley and Middle Atlantic States. In portions of Indiana, Missouri, southwestern Kansas, Arkansas, Oklahoma, and Texas corn was in need of rain to a greater or less extent. High winds flattened considerable corn in the Lake region on the 17th and 18th.

The weather conditions were favorable for thrashing, which work was in general progress. The reports respecting spring wheat were not favorable. The late sown in the Red River Valley, in Minnesota, was believed to be beyond recovery, while heavy rains kept the lowlands in the southern portion of the State flooded and caused lodging in the uplands. Rains in southeast and extreme northeast portions of North Dakota improved the crop, and in South Dakota spring wheat was filling well, except in the southeast portion, and in Iowa, where it was unfavorably affected by rust. In Wisconsin and Nebraska and on the north Pacific coast more favorable reports were received.

Much rust in oats was reported from the States of the Ohio and upper Mississippi valleys and Lake region, and upon the whole the condition of the crop was below previous anticipations. Harvest was in general progress.

Further improvement in the condition of cotton was general throughout the cotton belt, although it was grassy over a large part of the eastern districts. Cool nights were somewhat detrimental in the Carolinas, and need of rain was beginning to be felt in Oklahoma. While rapid growth was reported from nearly all districts, the crop continued late, though well cultivated in the central and western districts.

The tobacco crop was in need of rain in portions of Kentucky and Ohio, and sustained some damage from high winds and heavy rains in Wisconsin, but elsewhere the outlook was promising.

Haying continued under favorable conditions in the lower Missouri and upper Mississippi valleys and Lake region, where an excellent crop was being secured. In the Ohio Valley and Middle Atlantic States the yield was better than was expected.

DESTRUCTIVE LOCAL STORMS.

July 27.—The temperature during this week in the districts east of the Rocky Mountains was favorable, except in New England, where it was too cool, but the need of rain was quite generally felt in the central valleys and Southern States. Destructive local storms occurred in Minnesota, Missouri, and in the northern portion of the Middle Atlantic States. In California the week was abnormally cool, but otherwise favorable.

Over the northern portion of the corn belt the corn crop made good progress, and elsewhere fair advance was reported, but the crop was in general need of rain in the central and southern portions of the principal corn States. While no serious injury had yet resulted from drought the crop was threatened in portions of Kansas, Oklahoma, and Missouri.

Some winter wheat remained to be harvested in the northern portion of the Middle Atlantic States and the Lake region. While light yields were generally indicated, the crop was secured and was being thrashed under exceptionally favorable conditions, that in shock and stack having wholly escaped injury from moisture, which was quite widespread in the previous year. The condition of spring wheat continued unfavorable, especially over the northern portion of the spring-wheat region. An improvement, however, in the crop on fall-plowed lands in northern Minnesota was reported, but the late sown was poor, rust being prevalent in southern Minnesota and South Dakota. In North Dakota the heads were filling fairly well, but a poor crop was indicated.

Oats harvest progressed rapidly and favorably. In Illinois, Missouri, and Kansas the yields were lighter than were expected, but in Iowa the results were more favorable.

While there was an improvement in cotton, its advance was apparently less decided than in the previous week, especially in the central and portions of the western districts, where rain was generally needed. Good growth was reported from nearly all districts, but the plant continued small and was from two to four weeks late.

Tobacco needed rain in portions of Virginia, North Carolina, and Kentucky, but was mostly doing well elsewhere.

Rains injured hay in New England and the northern portion of the Middle Atlantic States, but where unfinished elsewhere haying progressed satisfactorily, a fine crop of excellent quality having been secured in the central valleys.

COOL WEATHER CHECKS MATURITY OF CROPS.

August 3.—Throughout the northern portions of the country, from New England to the north Pacific coast, the temperature was too low for best results, light frosts occurring in North Dakota; but in the Southern States it was more favorable, although clear and warmer weather was needed in the west Gulf districts. Portions of the South Atlantic and east Gulf States and the central and lower Mississippi valleys needed rain, but elsewhere east of the Rocky Mountains rains were ample, being excessively heavy in central and northeastern Texas, in the eastern portions of Nebraska and Kansas, and over areas in the Ohio Valley and east Gulf States. It had become very dry in the central and southern Rocky Mountain districts.

Corn improved generally, especially in Iowa, Nebraska, Kansas, and portions of Illinois, and the Lake region, the least favorable reports being received from Missouri and the Ohio Valley States, but the crop continued late.

Thrashing of winter wheat continued under favorable conditions, harvesting having been finished, except in portions of New York and Michigan and on the Pacific coast, with disappointing yields. General rains in the spring-wheat region of the upper Missouri and Red River of the North valleys checked the ripening of spring wheat and caused better filling of the heads. Harvesting was in progress, some of the early sown being cut in the northern portion, but was delayed by rains in South Dakota and Nebraska. Harvest was also in progress in Oregon with light yield, but of excellent quality. In Washington the crop was maturing slowly, but was filling well.

The improvement noted in the previous week in cotton continued generally throughout the cotton belt. It was fruiting well, although too rank growth in portions of the central and western districts, and shedding on sandy lands in the Carolinas was reported. Rains were detrimental in the central and southwestern portions of the cotton area in Texas, but were beneficial in the northern portion, while boll-weevils appeared more destructive in a few of the southwestern counties. Clear, warm weather was needed in Louisiana and Texas.

Tobacco needed rain in portions of the Ohio Valley and Virginia, but the general condition of the crop was promising. Rains caused injury to hay in Texas, New York, and Michigan, and delayed haying in South Dakota and New England; elsewhere this work progressed under favorable conditions.

August 10.—The northern districts east of the Rocky Mountains, as in the preceding week, experienced temperatures too low for rapid growth and maturity of crops, but elsewhere the temperature was very favorable. The rains were general and well distributed as a whole, but limited areas in the South Atlantic and Gulf States and portions of the upper Ohio and lower Missouri valleys continued to suffer from drought. The west Gulf coast districts and southeast Minnesota suffered from excessive rains, and cloudy, rainy weather was unfavorable for farm work in New England and the Middle Atlantic States. The weather conditions on the Pacific coast were favorable, especially for harvesting in Oregon and Washington.

Corn made favorable progress in the central and western portions of the corn belt, but in the upper Ohio Valley and Middle Atlantic States the outlook was less promising. While a marked improvement in corn occurred in the States of the Missouri and upper Mississippi valleys, in the more northerly portions of these States the crop was in need of warmth.

Rains checked somewhat the progress of spring wheat harvest, which, however, was now general throughout the spring wheat region. In North Dakota the weather was favorable for the development of late grain, while in southern Minnesota rust, fly, and chinch bugs seriously affected the crop.

Oat harvest was nearly finished except in New York, where it had just begun. The reports generally indicated that yields were disappointing.

Generally cotton made favorable progress, but continued unusually late. Some complaints of rust were received from South Carolina, Florida, and Mississippi, but as a rule very little complaint of rust or shedding was reported. The crop made good growth throughout the belt and was generally well fruited. No picking was reported.

EXTREMES OF WEATHER CONDITIONS—COTTON PICKING BEGINS.

August 17.—This was the third consecutive week of abnormally cool weather in the northern districts east of the Rocky Mountains, where warmth was greatly needed for maturing crops. More favorable temperature conditions prevailed in the Southern States, although in the northern portion of the central Gulf districts warmer weather would have been better. A large part of the Missouri Valley, and portions of the valleys of the upper Mississippi and the Red River of the North suffered from excessive moisture, while drought prevailed in the central and upper portions of the Ohio Valley, central and southern Texas, and in portions of Florida and Oklahoma. Rain was also needed on the North Pacific coast, where favorable temperature prevailed, but in California it was rather cool for fruit drying.

Throughout the northern and eastern portions of the corn belt the weather was too cool for maturing corn, which was unusually late. The crop, however, generally improved, especially in the central and western districts, the outlook being very promising in Kansas, where early corn was about made in the southern part of the State. In the northwestern portions of the corn belt, including Nebraska, Iowa, Wisconsin, and portions of Missouri and Illinois, there was urgent need of warmth and for the most part of sunshine.

Rains further checked the progress of spring wheat harvest in the Dakotas and Minnesota, but this work was nearly completed in the southern portion of the spring wheat region. Thrashing had commenced, but rains prevented rapid progress, and some injury to grain in shock was reported. In the central and northern Rocky Mountain and North Pacific coast districts spring wheat harvest was in progress under very favorable conditions.

Oats in shock and stack were injured by wet weather in portions of the Missouri and upper Mississippi valleys, where thrashing made slow progress; elsewhere thrashing continued uninterruptedly.

Cotton made rapid growth throughout the cotton belt, and in portions of the central and western districts and in eastern North Carolina complaint of too rapid growth was quite general; rust and shedding being also reported in the central and eastern districts, while heavy rains caused injury in portions of North Carolina, Alabama, Louisiana, and Arkansas. Boll-weevils were increasing in the southwestern and south-central cotton counties of Texas, and bollworms were appearing in northern Texas, but as yet the latter had caused little damage. Early cotton was now opening, and a little picking had been done in South Carolina, Florida, and Texas.

Cool weather affected tobacco unfavorably in Kentucky, Pennsylvania, and New England, and drought caused further injury in Ohio; elsewhere the crop made satis-

factory progress, cutting being in progress in Maryland, Ohio, Kentucky, Wisconsin, and New England.

DAMAGE TO TEXAS COTTON BY BOLL-WEEVILS—CORN CUTTING BEGINS.

August 24.—While complaints of cool nights, during the early part of this week, were received from the States of the central Mississippi and Ohio valleys, the temperature conditions throughout the country as a whole were very favorable, the upper Missouri and upper Mississippi valleys, Lake region, and Rocky Mountain districts, the greater part of which had suffered from abnormally low temperatures for several weeks, receiving more than normal heat. Portions of the South Atlantic States experienced heavy rains, while the Ohio Valley, the greater part of Texas, and the Rocky Mountain and Pacific coast districts were suffering from drought. There was some damage in the northern portion of the Middle Atlantic States by local storms on the 19th.

On the whole the corn crop made favorable progress, especially over the central and western portions of the corn belt, the most decided advance being reported from Nebraska and Kansas. In the upper Ohio Valley corn suffered seriously for rain, which was also needed in portions of Illinois and Missouri, and much of the late crop in Iowa was threatened by drought. At this time the reports indicated that early corn would be safe from frost by September 15 to October 1, and late corn by October 1 to 15.

Considerable spring wheat remained to be cut in North Dakota, but harvesting was practically finished elsewhere in the spring-wheat region, and thrashing was in progress. In southern Minnesota much grain in shock was damp. In South Dakota, Nebraska, and Kansas the weather was highly favorable for stacking and thrashing. Harvest was nearly finished in Oregon, and advanced rapidly in Washington, the grain being of superior quality.

Cotton suffered materially from heavy rains and lack of sunshine over a large part of the central and eastern districts of the cotton region, where, as in the previous week, rapid growth, and, in some localities, too much stalk, excessive shedding, and rust were reported. The plant, however, was generally well fruited throughout the belt. In Texas the boll-weevils were doing much damage, except in the northern counties, and bollworms were more numerous and destructive. A little picking had been done throughout the southern portions of the belt, but this work was not yet general.

COTTON PICKING GENERAL.

August 31.—In the northern districts eastward of the Rocky Mountains this week was abnormally cool with excessive rainfall, except over a few limited areas. In the Southern States and over the southern portions of the central valleys and Middle Atlantic States the temperature averaged above the normal and was generally favorable for the advance of crops, although portions of the South Atlantic and east Gulf districts suffered from excessive heat. Portions of the South Atlantic and east Gulf States, and of Tennessee, southern Missouri, Arkansas, and western Texas were in need of rain, while heavy rains in the Missouri Valley and Lake region delayed work, caused injury to grain in shock, and retarded the maturity of crops. Showers in the north Pacific coast States were highly beneficial.

Over the northern portion of the corn belt cool, wet weather was very unfavorable for the advance of corn, which was urgently in need of warm, dry weather. More favorable conditions prevailed over the southern portion of the corn belt, where the crop made good progress. The outlook in the upper Ohio Valley, where corn had suffered seriously from drought, was greatly improved by rains. Cutting was in progress in the southern portions of Kansas and Missouri.

Harvest of spring wheat was finished, except in the northern Rocky Mountain States and on the north Pacific coast, where rains delayed its completion. In the Dakotas, Nebraska, Minnesota, and Wisconsin stacking and thrashing were seriously interrupted and considerable damage was caused by excessive moisture.

While there was some improvement in cotton, mainly in portions of the central districts, the crop as a whole suffered deterioration, rust and shedding being very general throughout the belt, and premature opening in some of the eastern districts, where excessive heat also proved unfavorable. In Texas there was much shedding; and while bollworms were disappearing and the crop was more promising in the northern counties, the boll-weevils continued very destructive in the southwestern, central, and eastern portions. Picking was now general throughout the southern districts of the cotton belt.

DROUGHT IN SOUTHERN STATES—DETERIORATION OF COTTON—HEAVY RAINS IN SPRING-WHEAT REGION—BLIGHT AND ROT IN POTATOES.

September 7.—The weather conditions of this week were generally favorable in the Lake region and from the upper Mississippi and Missouri valleys westward to the Rocky Mountains, in New York and New England, portions of the Middle Atlantic States, and in Florida, but in the Ohio and lower Mississippi valleys, and generally throughout the Southern States, drought prevailed, in some sections becoming serious, retarding growth and maturity and causing considerable injury to crops. Rain was needed in Oklahoma and the southern plateau region.

Early corn matured rapidly, some fields being safe from frost, and cutting was progressing in southern and central sections of the corn belt. Late corn advanced satisfactorily generally in the great corn States, except Iowa, and under favorable conditions the bulk of the crop promised to be safe in two or three weeks.

Complaints of rust and shedding were general throughout the cotton belt, and as a result the condition of cotton deteriorated. It opened rapidly, in some sections prematurely, and picking became general in all districts. Favorable reports were received from North Carolina, Oklahoma, and portions of South Carolina and Mississippi, prospects being good for a top crop in the first-named State. In Texas, while the bollworms had mostly disappeared, boll-weevils continued destructive and were puncturing nearly all new forms in the southwestern, central, and eastern sections. The crop also suffered from drought in the northern and western portions of Texas.

September 14.—This week was excessively wet in the Missouri and upper Mississippi valleys and upper Lake region, while drought conditions over the greater part of the Southern States and Ohio Valley became more serious. The temperature conditions in the central valleys and Atlantic coast districts were highly favorable, but abnormally cool weather prevailed in the central and northern Rocky Mountain districts and upper Missouri Valley, where thermometer readings ranging from 2° to 6° below freezing were recorded on the 13th and 14th, with frosts more or less injurious. Damaging frosts also occurred in the northern portions of New York and New England. The tropical hurricane that crossed the lower Florida Peninsula on the 11th and 12th was accompanied by torrential rains and winds of destructive violence. In California the conditions were very favorable, but cool, wet weather in Washington and Oregon delayed work and caused some injury to grain in shock.

Except in Iowa, northern Missouri, and eastern Nebraska, where excessive moisture prevented rapid ripening, the corn crop made satisfactory progress, the bulk of the early planted over the southern portion of the belt being practically safe from frost. In Iowa, northern Missouri, and eastern Nebraska the advance of the crop was very slow. The northwest portion of the corn belt was threatened with damage from cold, the freezing temperatures occurring in the northern Rocky Mountain districts having extended as far eastward as the western portions of the Dakotas and northwest Nebraska on the 14th and 15th, but no serious injury resulted, except in the Dakotas.

Further delay in thrashing of spring wheat in the spring-wheat region east of the Rocky Mountains resulted from excessive rains, and there was considerable damage to wheat in stack and shock. Delay in thrashing and injury to grain were also reported from Washington, Oregon, and Idaho.

Further deterioration in the condition of cotton was very generally reported throughout the cotton belt. Shedding and rust were extensive, and quite general complaints of premature opening were received from the central and eastern districts. The greater part of the cotton belt was now suffering from drought, and bollworms were destructive in localities. Boll-weevils continued to destroy nearly all new forms in the southwestern, central, and eastern portions of the cotton area in Texas. Cotton opened fast in all districts and picking progressed rapidly.

Blight and rot in potatoes in the northern districts eastward of the Mississippi Valley were widespread, causing a marked decline in the condition of this crop.

SLIGHT INJURY TO LATE TOBACCO—DROUGHT IN OHIO VALLEY AND TENNESSEE—DAMAGE TO CORN BY FROSTS.

September 21.—While this week was abnormally cool, with general frosts throughout the central valleys and as far south as the northern portion of the central Gulf States, the damage was not serious, except in the extreme western portions of Kansas and Nebraska, the Dakotas, Minnesota, Wisconsin, and New England. The South Atlantic States suffered from excessive moisture, while the heavy rains of the previous week over the northern portions of the Missouri and upper Mississippi valleys delayed thrashing of spring wheat and caused grain in shock to sprout.

Drought was largely relieved in the east Gulf States, but continued in the Ohio Valley, Tennessee, and the central and west Gulf States. The Pacific coast States experienced a very favorable week.

Notwithstanding the occurrence of light to heavy frosts generally throughout the corn belt, the corn crop escaped injury, except in the western portions of Kansas and Nebraska, and in the Dakotas, Minnesota, and Wisconsin. While low temperature prevented rapid ripening, especially over the western districts, the crop as a whole advanced favorably, although the late planted in the Ohio Valley and Tennessee suffered from drought. A large part of the crop was now safe, the bulk of the unmatured requiring from one to two weeks of favorable weather.

Except in portions of the eastern districts of the cotton belt, where cotton picking was interrupted by rains, the weather conditions were very favorable for gathering the crop, and this work progressed rapidly. The prevalence of rust, shedding, and bollworms was widespread, and the boll weevils in Texas continued destructive. Premature opening in South Carolina, rust in Georgia, and shedding in Alabama were somewhat checked. Heavy rains injured the staple in Georgia, South Carolina, and Florida. Cotton opened rapidly in all districts.

Late tobacco suffered from drought in Tennessee and Kentucky and heavy rains in North Carolina, and frosts caused some injury in Kentucky, while damp weather proved injurious to tobacco in barns in Maryland. Plowing and seeding advanced satisfactorily except in the Ohio Valley and Tennessee, where the soil was too dry, and in the northern portion of the Middle Atlantic States, where there was too much rain.

LIGHT RAINFALL—FAVORABLE FOR MATURING CORN AND PICKING COTTON.

September 28.—The temperature conditions were generally favorable, although cool nights were detrimental in the South Atlantic, eastern, and central Gulf States, while light to heavy frosts, for the most part causing no serious injury, occurred in the more northerly districts eastward of the upper Missouri Valley. A marked feature of the week was the absence of rain, or the occurrence of only very light showers over much the greater part of the country east of the Rocky Mountains, there being only a few areas of comparatively limited extent in the upper Mississippi Valley, Lake region, and the coast districts of the Middle Atlantic States and southern New England in which the rainfall exceeded the average. Drought continued in the Ohio Valley and with increased severity in Tennessee and the central and west Gulf States. No unfavorable conditions were reported from the Pacific coast, although rain in southern California probably caused slight injury. Southern Arizona and southwestern New Mexico received unusually heavy rains for that region, more than 2 inches being reported from several stations.

The principal corn States experienced weather conditions exceptionally favorable for maturing late corn, and, while frosts were quite general over the central and eastern portions of the corn belt, no material damage resulted. At this time probably less than 20 per cent of the crop in Iowa was unmatured, and while the proportion yet exposed to injury in South Dakota, Minnesota, and Wisconsin was greater, the immature promised to make good feed; farther south only a very small part of the crop was still soft. Cutting was general in all sections and some new corn marketed in southern Kansas.

With generally seasonable temperature and practically no rain over nearly the entire cotton belt, cotton opened rapidly and picking was actively carried on, a considerable part of the crop having already been gathered. Cool nights and the very general prevalence of drought in the central and western districts were detrimental, and rust and shedding continued to be extensively reported, although rust was somewhat less prevalent in Georgia. On the whole the crop suffered deterioration, especially in the central and western portions of the belt. In Texas the plant had almost entirely ceased fruiting, and in some central counties was dying.

October 5.—In all districts east of the Rocky Mountains the temperature conditions during this week were highly favorable for unmatured crops. The northern portions of the upper Missouri and upper Mississippi valleys and upper Lake region, and parts of Texas, Oklahoma, and Arkansas, however, suffered from excessive rains, while severe drought continued in the South Atlantic, central and east Gulf States, and in portions of Tennessee and the Ohio Valley. On the Pacific coast the week averaged cool, with showers during the latter part, which, in portions of California, were unfavorable for fruit drying. New Mexico and Arizona received additional and beneficial rains.

On the whole, the corn crop experienced another very favorable week, although the more northerly portions of the corn belt, in which rains retarded maturing and cutting, would have done better with less moisture. In Iowa 10 to 15 per cent of

the area planted was still exposed in some measure to damage by heavy frost; in Nebraska, Kansas, Illinois, Missouri, Michigan, and Wisconsin about 10 per cent of the crop was still exposed to injury from frost; in Indiana and southern Ohio about 5 per cent, and in northern Ohio from 5 to 25 per cent, except in the extreme northeast portion, where from one-half to three-fourths or more was still green. In Wisconsin, Minnesota, and South Dakota from 10 to 40 per cent had already been injured to a greater or less extent.

In the central and eastern districts of the cotton belt there was little or no rain and cotton picking progressed rapidly under very favorable conditions. In Texas, Oklahoma, and Arkansas, however, picking was retarded by heavy rains, which caused considerable damage to open cotton, especially in Texas, where the opening of the young bolls had been checked by renewed growth.

Except in the Middle and South Atlantic States and the portions of the Ohio and central Mississippi valleys where plowing and fall seeding were retarded, this work made satisfactory progress, and early sown wheat had germinated and was coming up well, fine stands being reported from Nebraska and Kansas. Rains in Texas put the soil in excellent condition, and seeding was now active in that State.

October.

As a whole, the month averaged mild and was generally favorable for farming operations, although plowing and fall seeding were delayed, on account of dry soil, in portions of the central Mississippi and Ohio valleys, and late crops in the central and east Gulf States suffered from drought. The Middle Atlantic States experienced abnormally heavy rains and very high winds during the latter part of the first decade, causing damaging freshets in northern New Jersey and southeastern New York. Heavy and killing frosts occurred in the central and east Gulf and South Atlantic States from the 25th to the 28th, with freezing temperatures as far south as the northern portions of Mississippi, Alabama, Georgia, and South Carolina.

The month was generally favorable for cotton picking, which work at the close of the month was nearly completed over a large part of the central and eastern districts of the cotton belt, and was progressing rapidly in Arkansas, Oklahoma, and northeastern Texas, where much of the crop remained to be gathered.

In the central Gulf States, Ohio Valley, and the States of the middle Rocky Mountain slope the absence of rain materially interfered with fall seeding and the germination of sown grain. In the Missouri Valley, Lake region, and Middle Atlantic States plowing and seeding were carried on under favorable conditions and germination was satisfactory.

November.

The most prominent features of the month were the low temperature during the latter half in the districts east of the Rocky Mountains and the generally light precipitation in the same districts. Freezing temperature reached the Gulf coats on the 18th to the 20th and again on the 28th and 29th, while over a large area from central Texas to the South Pacific coast, including portions of Colorado and Wyoming, there was no appreciable precipitation.

Over a large part of the winter-wheat area the stands of winter wheat were not satisfactory, owing to general lack of moisture, and the Hessian fly caused injury in portions of Kansas, Missouri, and Indiana. In Oklahoma, Kansas, Nebraska, and northern Missouri winter wheat was in better condition for the winter than in the more easterly portions of the wheat belt. In the Middle Atlantic States the early sown was in more promising condition than the late sown, which suffered from lack of moisture.

At the close of the month the Lake region, the northern portion of New England, and the central Ohio and upper Missouri valleys were covered with snow, a considerable depth being reported from northern New England and the upper Lake region, the upper Michigan Peninsula along the southern shore of Lake Superior being covered to depths ranging from 16 to 23 inches.

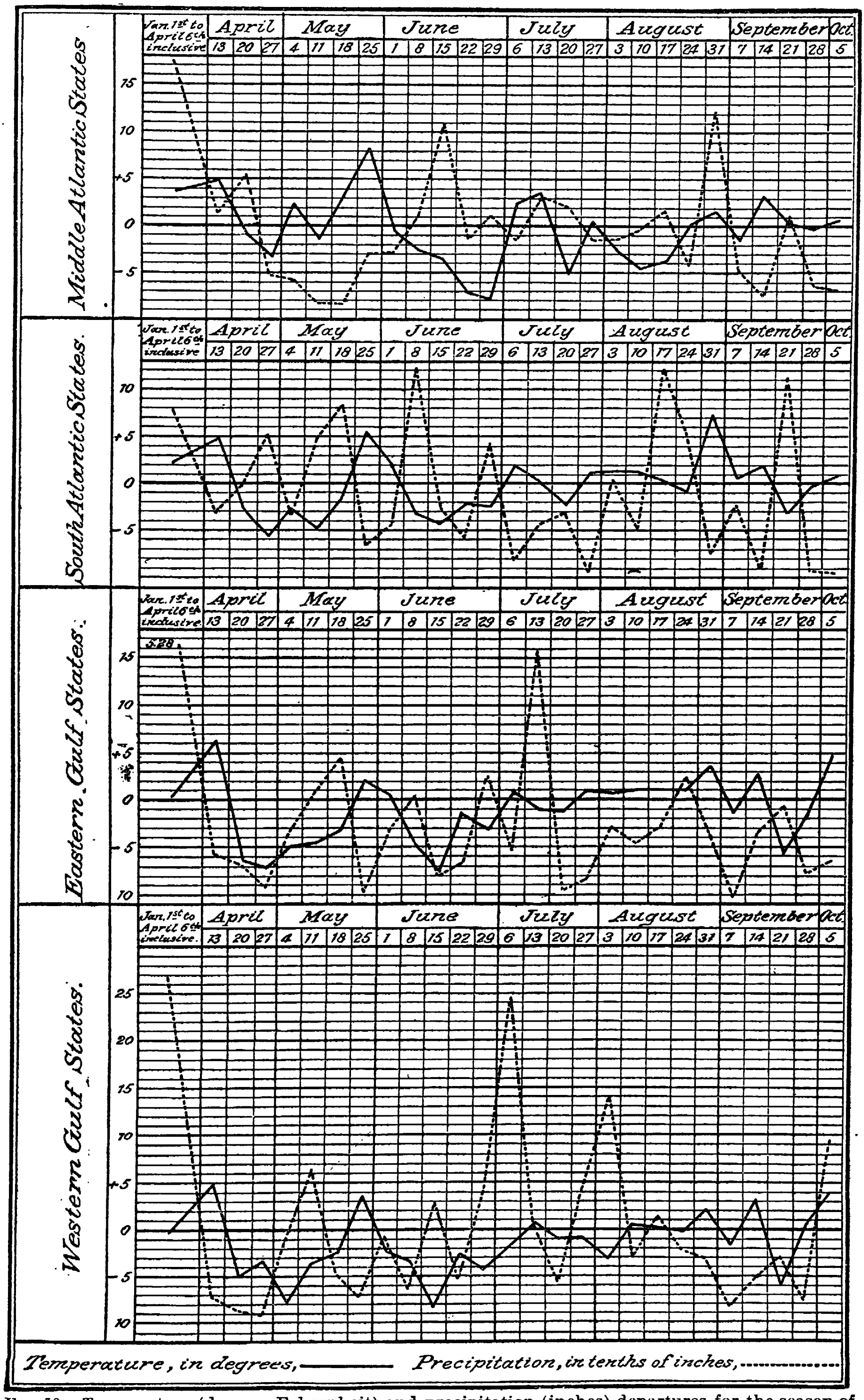


FIG. 50.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1903 from the normal of many years for the Middle and South Atlantic States, and Gulf States.

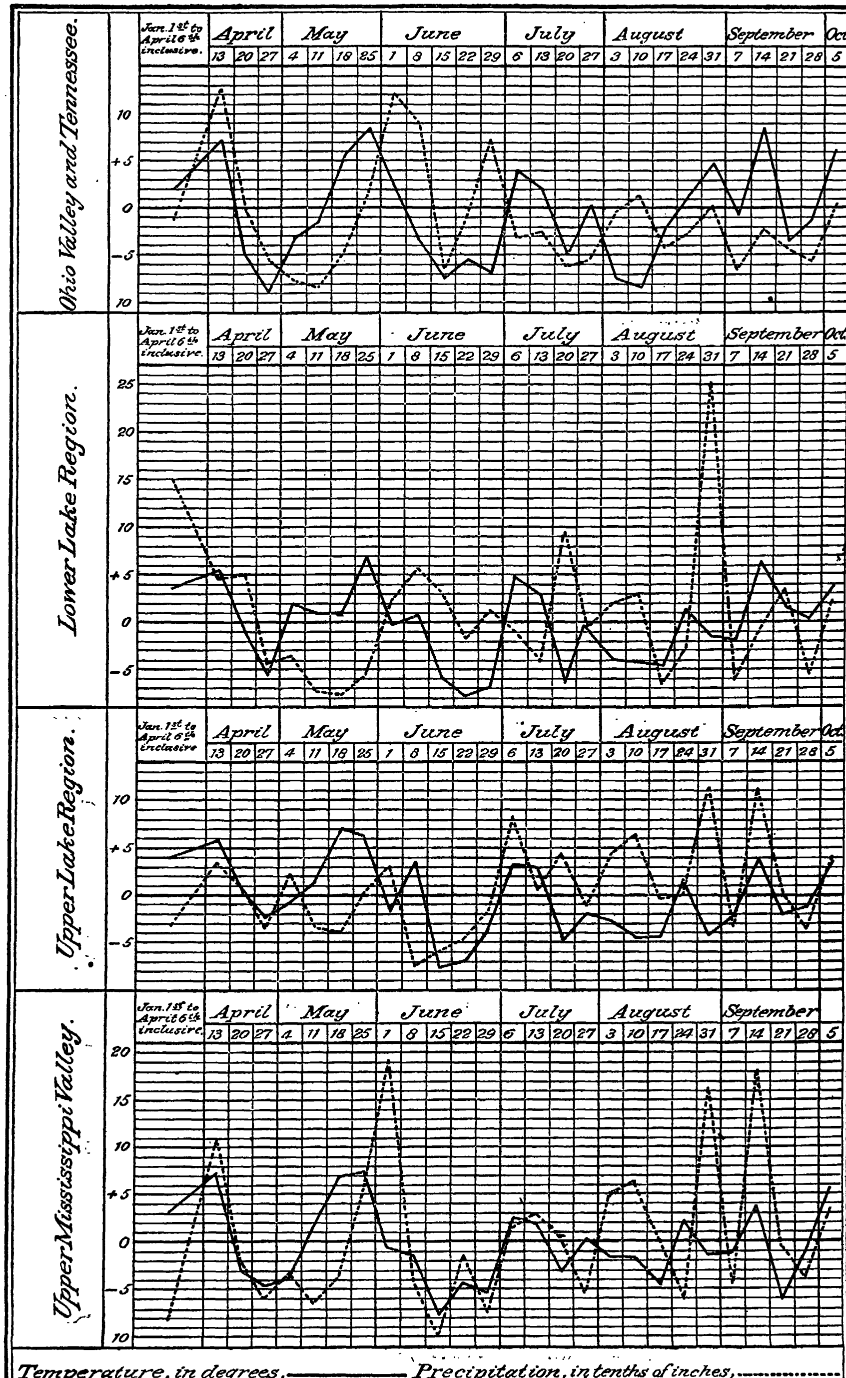


FIG. 51.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1903 from the normal of many years for the Lake Region, the Upper Mississippi Valley, the Ohio Valley and Tennessee.

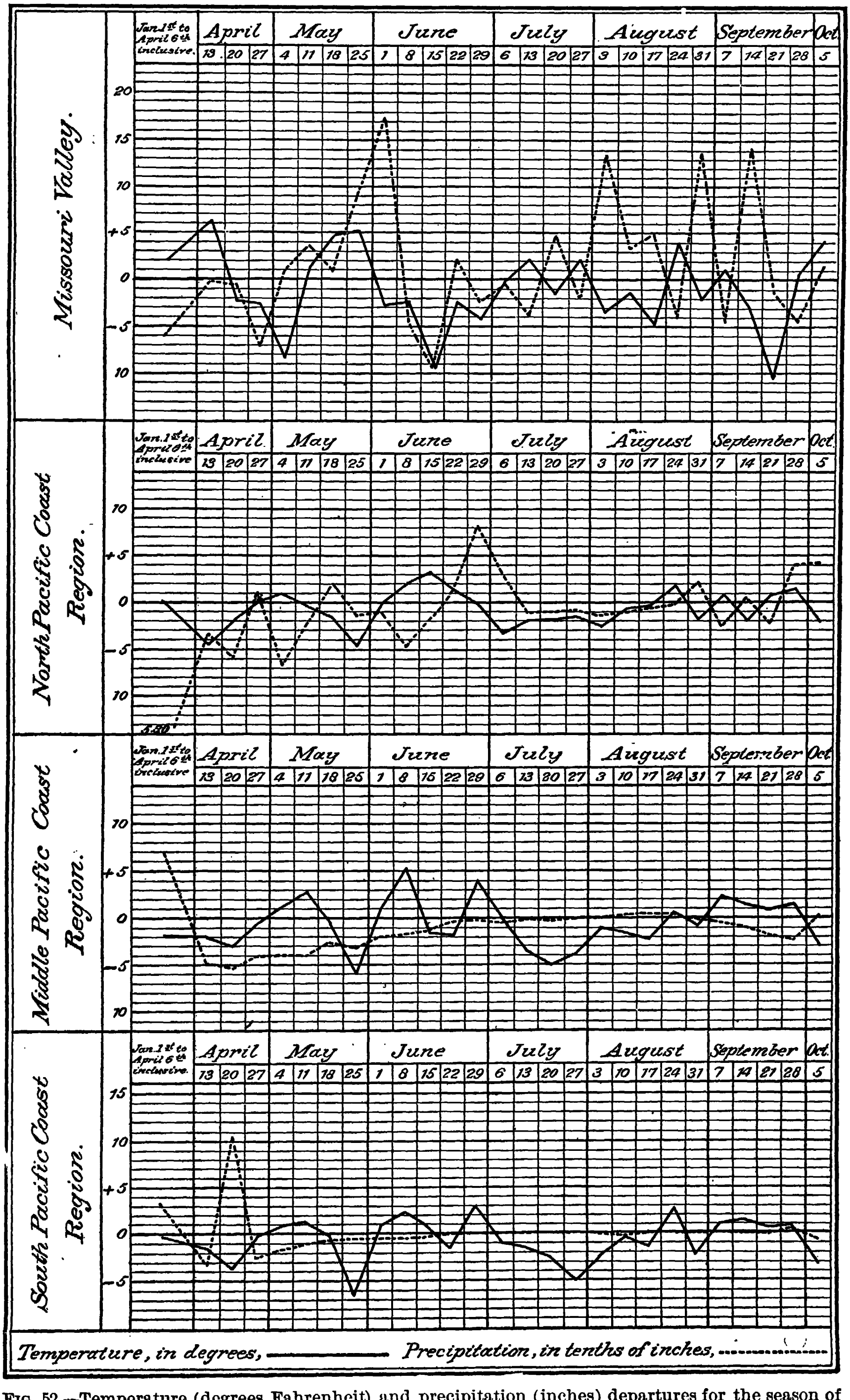
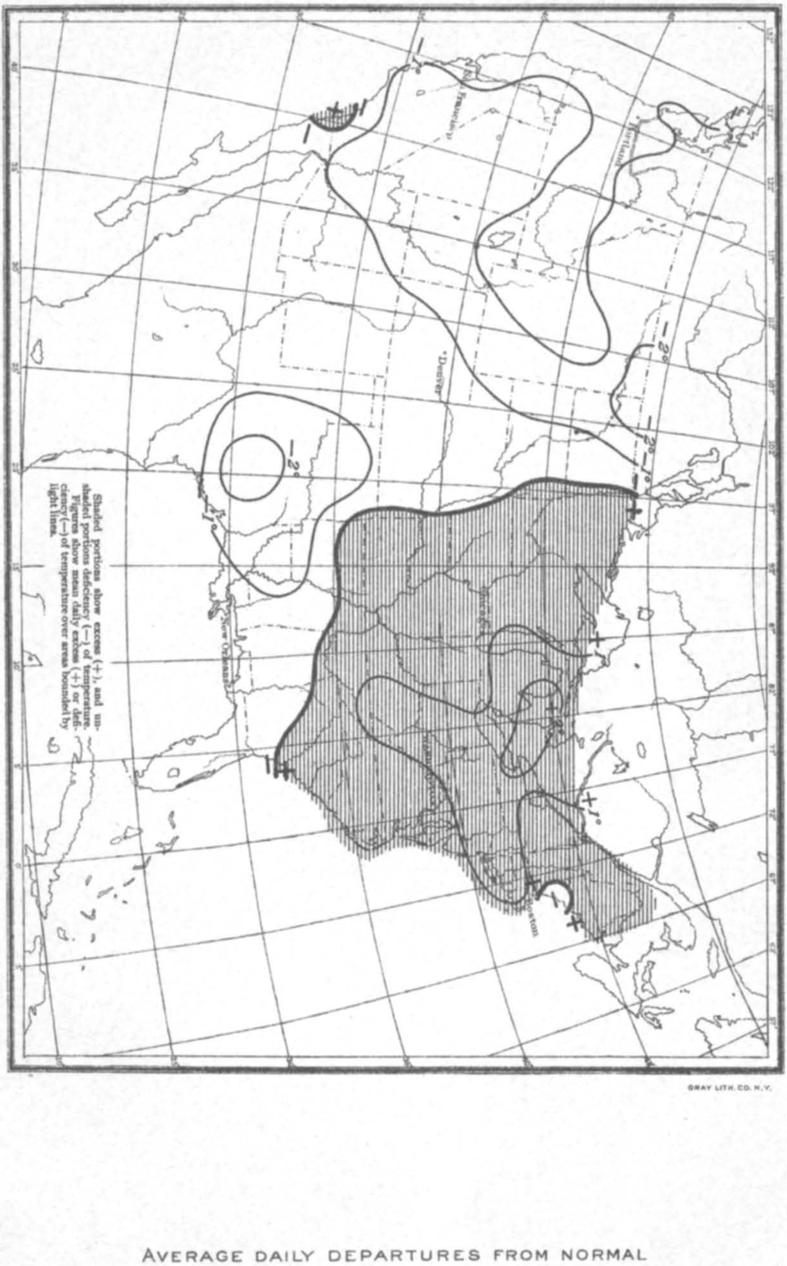


FIG. 52.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1903 from the normal of many years for the Missouri Valley and the Pacific coast.

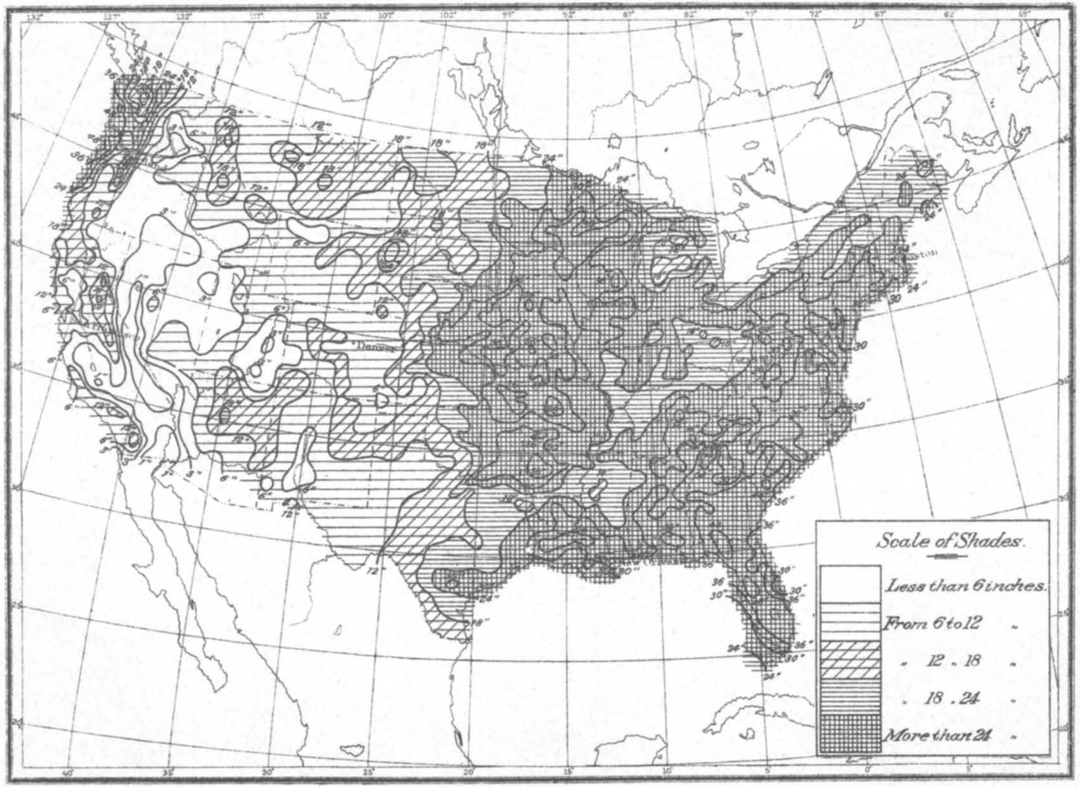
Average daily temperature departures (degrees Fahrenheit) for season of 1903 from normal based upon observations for many years, by sections.

Sections.	From Jan. 1 to Apr. 6, inclusive.	For weeks ended—											
		April—			May—				June—				
		13.	20.	27.	4.	11.	18.	25.	1.	8.	15.	22.	29.
New England	+3.8	+4.4	−2.2	−0.9	+2.0	−1.1	+4.1	+ 5.2	−0.9	−0.4	− 1.5	−9.6	−8.2
Middle Atlantic States	+3.7	+4.9	−0.8	−3.1	+2.4	−1.4	+3.4	+ 8.1	−0.5	−2.6	− 3.5	−7.1	−7.9
South Atlantic States	+2.2	+4.8	−2.8	−5.7	−2.7	−4.9	−1.6	+ 5.6	+2.0	−3.2	− 4.3	−2.2	−2.6
Florida Peninsula	+2.1	+1.7	−3.0	−5.0	−2.3	−2.0	−1.3	− 0.7	+0.7	0.0	− 0.3	+0.3	−0.3
Eastern Gulf States	+0.2	+6.3	−6.4	−7.1	−5.0	−4.6	−3.1	+ 2.1	+0.4	−4.7	− 7.7	−1.4	−3.1
Western Gulf States	−0.2	+4.9	−5.0	−3.4	−7.9	−3.7	−2.4	+ 3.6	−2.3	−3.4	− 8.3	−2.6	−4.3
Ohio Valley and Tennessee	+2.0	+7.2	−5.5	−8.9	−3.3	−1.5	+5.7	+ 8.5	+2.6	−3.3	− 7.2	−5.4	−6.9
Lower Lake region	+3.6	+5.5	−0.8	−5.6	+2.0	+0.9	+1.0	+ 6.9	−0.2	+0.9	− 5.9	−7.9	−6.9
Upper Lake region	+4.0	+5.9	+0.5	−2.4	−0.9	+1.5	+7.1	+ 6.3	−1.7	+3.5	− 7.6	−6.9	−3.6
North Dakota	+2.3	+4.0	+4.3	+3.0	−8.3	−0.3	+9.0	− 3.7	−1.0	+5.0	− 5.7	−3.0	−0.3
Upper Mississippi Valley	+3.1	+7.3	−3.0	−4.7	−3.8	+1.4	+6.9	+ 7.4	−0.7	−1.4	− 7.6	−4.5	−5.4
Missouri Valley	+2.0	+6.3	−2.3	−2.6	−8.3	+1.3	+4.8	+ 5.2	−2.8	−2.2	− 9.4	−2.3	−4.1
Northern slope	+0.6	+0.9	+0.9	+4.4	−9.3	−0.1	+3.6	− 7.6	−1.1	+2.6	− 2.3	+0.1	−1.3
Middle slope	+0.3	+4.2	−0.3	−0.3	−9.3	−0.7	−0.2	+ 2.3	−5.0	−5.3	−10.3	−1.2	−5.8
Southern slope	−0.6	+3.5	−3.0	−2.0	−9.5	−5.5	−3.0	+ 2.0	−3.0	−8.0	−15.0	−3.0	−3.0
Southern plateau	−1.2	−0.8	−4.2	+2.6	−0.8	+1.6	+0.4	−10.2	−1.2	−0.8	− 5.4	−2.2	+1.6
Middle plateau	−4.6	−4.5	−3.2	+3.5	−2.5	+2.2	−0.8	−10.8	−0.2	+2.8	+ 1.5	+0.5	+1.8
Northern plateau	+0.7	−5.6	−1.2	+2.0	−4.4	+0.4	−1.4	− 9.2	+2.6	+4.4	+ 9.6	+5.6	+1.0
North Pacific coast region	+0.1	−4.6	−1.9	0.0	+1.0	−0.3	−1.6	− 4.6	0.0	+2.1	+ 3.3	+1.3	−0.1
Middle Pacific coast region	−1.9	−2.0	−3.0	−0.5	+1.2	+2.8	−0.5	− 6.0	+1.0	+5.2	− 1.5	−1.8	+4.0
South Pacific coast region	−0.2	−1.5	−3.8	−0.2	+0.8	+1.2	−0.2	− 6.5	+0.8	+2.2	+ 0.8	−1.5	+3.0



GRAY LITH. CO. N.Y.

AVERAGE DAILY DEPARTURES FROM NORMAL TEMPERATURE FOR THE CROP SEASON OF 1903, FROM MARCH 1 TO OCTOBER 5.



THE TOTAL PRECIPITATION FOR THE CROP SEASON OF 1903. FROM MARCH 1 TO OCTOBER 5.

GRAY LITH. CO. N.Y.

THE DEPARTURES FROM NORMAL PRECIPITATION
FOR THE CROP SEASON OF 1903,
FROM MARCH 1 TO OCTOBER 5.

Average daily temperature departures (degrees Fahrenheit) for season of 1903 from normal based upon observations for many years, by sections—Cont'd.

Sections.	For weeks ended— July— 6.	13.	20.	27.	August— 3.	10.	17.	24.	31.	September— 7.	14.	21.	28.	Oct. 5.
New England	−0.6	+5.0	−4.0	−1.9	−3.9	−8.6	−3.5	+0.2	−4.8	−0.5	+ 2.0	+ 3.8	+0.9	+0.4
Middle Atlantic States	+2.5	+3.5	−5.1	+0.5	−2.5	−4.6	−3.8	+0.2	+1.6	−1.5	+ 3.3	+ 0.3	−0.3	+0.5
South Atlantic States	+1.9	+0.1	−2.3	+1.2	+1.3	+1.3	+0.3	−1.0	+7.4	+0.6	+ 1.9	− 3.2	−0.3	+0.8
Florida Peninsula	−0.3	+0.3	−0.7	0.0	−0.3	+1.3	+0.7	+1.3	+2.3	+1.0	− 0.7	0.0	−2.0	+1.0
Eastern Gulf States	+0.7	−1.0	−1.3	+0.9	+0.6	+1.0	+1.0	+1.0	+3.6	−1.4	+ 2.8	− 5.9	−1.6	+4.8
Western Gulf States	−2.0	+0.6	−1.0	−0.9	−3.1	+0.6	+0.1	−0.1	+2.1	−1.7	+ 3.1	− 5.9	+0.4	+4.0
Ohio Valley and Tennessee	+4.1	+2.0	−5.0	+0.3	−7.3	−8.2	−2.1	+1.4	+4.7	−0.7	+ 8.5	− 3.5	−1.2	+6.1
Lower Lake region	+4.9	+2.9	−6.2	−0.2	−3.8	−4.1	−4.6	+1.4	−1.4	−1.8	+ 6.4	+ 1.6	+0.2	+3.9
Upper Lake region	+3.3	+3.0	−4.8	−2.0	−2.8	−4.6	−4.5	+1.7	−4.3	−2.1	+ 3.8	− 2.0	−1.1	+3.7
North Dakota	−4.0	−2.7	−2.7	+4.0	−8.0	−4.7	−1.7	+2.7	−4.7	−1.0	− 1.3	− 6.3	−1.3	+1.7
Upper Mississippi Valley	+2.5	+1.9	−3.1	+0.2	−1.7	−1.7	−4.5	+2.2	−1.4	−1.1	+ 3.7	− 6.1	−0.9	+5.6
Missouri Valley	−0.2	+2.1	−1.5	+2.2	−3.4	−1.4	−4.8	+4.0	−2.0	+1.1	− 3.0	−10.5	+0.6	+4.2
Northern slope	−6.0	−1.7	−1.3	+5.1	−5.9	−2.1	−0.6	+5.4	−2.3	+2.3	−10.4	− 6.9	+3.6	+2.0
Middle slope	−1.7	+3.7	+1.2	+3.7	−1.5	+0.7	−1.3	+2.8	+2.2	+4.0	− 1.0	−11.5	+1.5	+4.3
Southern slope	−0.5	+1.0	+1.5	+3.5	0.0	+3.0	+2.0	+2.0	+6.0	+3.0	+ 2.5	− 9.0	0.0	+4.5
Southern plateau	−0.6	+0.4	−1.6	−0.8	+1.6	+0.6	+1.0	+4.0	+1.2	+4.8	+ 0.2	− 2.8	+0.2	−4.4
Middle plateau	−5.2	−3.5	−2.0	−2.2	−1.5	+0.2	−1.2	+3.5	−2.5	+2.5	− 9.0	− 6.8	+3.5	−2.2
Northern plateau	−8.4	−3.4	−2.2	+0.4	−4.2	+0.2	+1.4	+1.2	−2.8	+1.0	− 9.0	− 1.8	+2.8	−2.8
North Pacific coast region	−3.4	−2.0	−1.9	−1.6	−2.6	−0.6	−0.4	+1.9	−1.9	+0.9	− 2.0	+ 0.9	+1.6	−2.0
Middle Pacific coast region	0.0	−3.5	−5.0	−3.8	−1.0	−1.5	−2.2	+0.5	−0.8	+2.2	+ 1.5	+ 1.0	+1.5	−3.0
South Pacific coast region	−1.0	−1.5	−2.5	−5.0	−2.5	−0.5	−1.5	+2.8	−2.2	+1.0	+ 1.5	+ 0.5	+0.8	−3.2

Precipitation departures (inches and hundredths) for the season of 1903 from normal based upon observations for many years, by sections.

Sections.	From Jan. 1 to Apr. 6, inclusive.	For weeks ended—											
		April—			May—				June—				
		13.	20.	27.	4.	11.	18.	25.	1.	8.	15.	22.	29.
New England	+1.63	+0.76	+0.31	-0.70	-0.70	-0.69	-0.77	-0.74	-0.47	-0.52	+1.56	+0.95	-0.38
Middle Atlantic States	+1.75	+ .13	+ .55	- .51	- .58	- .83	- .84	- .30	- .29	+ .11	+1.08	- .13	+ .11
South Atlantic States	+ .79	- .31	.00	+ .52	- .35	+ .49	+ .82	- .65	- .44	+1.21	- .26	- .59	+ .43
Florida Peninsula	+7.51	- .17	- .44	- .34	- .55	- .01	+ .23	- .87	-1.01	- .14	- .98	- .01	- .40
Eastern Gulf States	+5.28	- .59	- .69	- .92	- .35	+ .09	+ .44	- .97	- .31	+ .02	- .80	- .67	+ .26
Western Gulf States	+2.69	- .71	- .87	- .92	- .10	+ .64	- .47	- .73	- .07	- .64	+ .28	- .53	+ .41
Ohio Valley and Tennessee	- .12	+1.27	- .04	- .57	- .76	- .83	- .49	+ .15	+1.20	+ .90	- .64	- .06	+ .75
Lower Lake region	+1.50	+ .45	+ .50	- .44	- .35	- .73	- .77	- .57	+ .23	+ .58	+ .33	- .17	+ .13
Upper Lake region	- .31	+ .34	+ .07	- .36	+ .22	- .33	- .39	+ .03	+ .30	- .74	- .60	- .47	- .17
North Dakota	- .20	- .03	- .33	- .29	- .48	- .39	- .09	+1.93	- .13	- .68	- .63	- .68	- .73
Upper Mississippi Valley	- .81	+1.08	- .20	- .60	- .31	- .65	- .37	+ .55	+1.92	- .42	-1.00	- .13	- .74
Missouri Valley	- .60	- .01	- .05	- .71	+ .10	+ .36	+ .09	+ .96	+1.75	- .46	- .95	+ .21	- .23
Northern slope	- .15	- .07	+ .30	- .35	+ .03	+ .16	- .02	+ .20	- .38	- .16	- .33	+ .09	- .03
Middle slope	+ .31	- .30	- .49	- .53	+ .50	- .05	- .26	+1.48	+1.60	- .21	- .23	- .10	- .25
Southern slope	+2.64	- .36	- .54	- .55	- .24	+ .82	- .68	- .52	- .80	+1.18	- .21	+ .03	- .61
Southern plateau	- .39	+ .07	+ .09	+ .01	- .09	- .07	- .03	- .09	- .06	+ .45	+ .69	- .01	- .09
Middle plateau	- .12	- .09	- .23	- .12	- .24	- .21	- .04	+ .56	+ .06	- .08	+ .21	- .06	- .04
Northern plateau	-2.61	.00	- .30	- .16	- .26	- .23	+ .19	- .15	- .02	+ .02	- .09	- .19	- .07
North Pacific coast region	-5.30	- .34	- .59	+ .11	- .66	- .22	+ .20	- .14	- .10	- .47	- .16	+ .15	+ .82
Middle Pacific coast region	+ .69	- .49	- .53	- .41	- .40	- .40	- .26	- .32	- .20	- .17	- .12	- .03	- .02
South Pacific coast region	+ .34	- .32	+1.05	- .25	- .16	- .10	- .07	- .05	- .05	- .05	- .03	.00	.00

Precipitation departures (inches and hundredths) for the season of 1903 from normal based upon observations for many years, by sections—Continued.

Sections.	For weeks ended—													
	July—				August—					September—				Oct. 5.
	6.	13.	20.	27.	3.	10.	17.	24.	31.	7.	14.	21.	28.	
New England	−0.39	−0.29	0.00	−0.16	−0.40	+0.51	−0.61	−0.40	+0.23	−0.32	−0.66	−0.10	−0.16	−0.60
Middle Atlantic States	− .16	+ .31	+ .21	− .14	− .13	− .03	+ .17	− .42	+1.22	− .47	− .75	+ .11	− .63	− .69
South Atlantic States	− .81	− .42	− .31	− .94	+ .04	− .49	+1.21	+ .51	− .73	− .22	− .91	+1.12	− .92	− .97
Florida Peninsula	+ .44	+ .33	− .01	− .42	+ .20	− .30	− .05	− .28	−1.29	+ .53	+3.84	− .64	−1.76	−1.37
Eastern Gulf States	− .55	+1.59	− .97	− .84	− .29	− .47	− .28	+ .25	− .35	−1.02	− .34	− .07	− .77	− .64
Western Gulf States	+2.46	+ .06	− .57	+ .46	+1.40	− .29	+ .14	− .21	− .31	− .83	− .52	− .30	− .78	+ .94
Ohio Valley and Tennessee	− .31	− .24	− .62	− .55	− .05	+ .14	− .42	− .28	+ .01	− .66	− .22	− .43	− .57	+ .03
Lower Lake region	− .10	− .40	+ .94	− .04	+ .20	+ .29	− .66	− .28	+2.51	− .62	− .07	+ .36	− .56	+ .23
Upper Lake region	+ .84	+ .06	+ .45	− .11	+ .45	+ .65	− .04	.00	+1.12	− .32	+1.10	+ .01	− .36	+ .41
North Dakota	+ .86	+ .02	− .50	− .10	+ .26	+ .05	− .20	+1.43	+1.41	+ .05	+1.79	− .09	− .06	+ .67
Upper Mississippi Valley	+ .14	+ .29	+ .03	− .55	+ .50	+ .64	+ .01	− .61	+1.63	− .46	+1.81	− .06	− .39	+ .36
Missouri Valley	− .05	− .39	+ .48	− .21	+1.35	+ .33	+ .49	− .40	+1.37	− .45	+1.43	− .13	− .43	+ .15
Northern slope	+ .22	− .03	+ .02	+ .12	+ .47	+ .05	+ .11	+ .01	+ .30	− .04	+ .68	− .10	− .17	+ .12
Middle slope	− .21	− .09	− .37	− .51	+ .49	− .21	− .67	− .32	− .32	− .42	+ .36	− .28	− .38	− .12
Southern slope	− .64	− .48	+1.02	− .56	+ .13	− .32	+ .92	− .56	+ .62	− .60	+ .54	+ .31	− .46	+2.08
Southern plateau	− .16	− .01	− .25	− .23	− .31	− .18	− .08	− .08	+ .01	− .06	− .15	− .15	+1.07	+ .22
Middle plateau	+ .02	− .10	+ .07	.00	− .08	− .10	− .07	− .05	− .14	− .06	+ .02	− .14	− .15	+ .25
Northern plateau	+ .18	− .09	− .07	+ .02	− .04	− .03	− .04	+ .26	+ .54	+ .12	+ .41	− .17	− .21	+ .38
North Pacific coast region	+ .31	− .11	− .10	− .08	− .13	− .11	− .06	− .02	+ .22	− .25	+ .06	− .22	+ .40	+ .42
Middle Pacific coast region	− .04	− .01	− .02	.00	.00	+ .02	+ .04	+ .04	− .01	− .04	− .09	− .18	− .23	+ .02
South Pacific coast region	.00	.00	.00	.00	− .01	− .02	.00	.00	− .01	.00	− .01	− .02	+ .05	− .07

PLANT DISEASES IN 1903.

By W. A. Orton, *Pathologist.*

APPLES, PEARS, AND QUINCES.

The bitter rot of apples has not caused such heavy losses as in some previous years, though it has been of widespread occurrence. Injury was reported from Rhode Island, Pennsylvania, Michigan, southeastern Ohio, West Virginia, Virginia, the Carolinas, and Georgia. In southern Illinois and Indiana and in southern Missouri the damage was less, owing to the short apple crop. In Nebraska it seems to be on the increase. Hermann von Schrenk and Perley Spaulding, of this Department, have worked on the life history and synonymy of the fungus, and find it should be renamed *Glomerella rufomaculans.*

Apple scab (*Venturia inæqualis*) was much less injurious in New England, New York, Pennsylvania, and Michigan than last year, but it seems to have been more destructive in the West, especially in Wisconsin, eastern Nebraska, and Missouri. It is on the increase on the Pacific coast, in Montana, Idaho, Washington, and California. The pink mold (*Cephalothecium roseum*), which occurs secondarily in connection with scab, was also less abundant this year in New York and New England.

Apple canker or brown-rot (*Sphæropsis malorum*) was prevalent in Connecticut, Ohio, New York, and Michigan, causing much damage, especially in neglected orchards. The *Nummularia* canker was common in Missouri and adjoining States, though not very destructive. Blackspot canker was serious in Washington and Oregon, as heretofore. *Nectria ditissima* was found for the first time in Connecticut by G. P. Clinton. Black-heart, a disease affecting the wood of apple trees, was reported from Montana, Nebraska, Iowa, Kansas, and adjacent States. Observations by P. J. O'Gara, of this Department, indicate that the cause of this disease is *Bacterium mali* Brz., recently described by Brzezinski as the cause of apple canker in Europe. Frost bands were very common on apples and pears in New England and New York, owing to a late frost.

Pear blight (*Bacillus amylovorus*) was more than usually prevalent this year in the East. In the South it is universal and little effort is made to control it. In Colorado it has spread rapidly, and most of the pear trees are being cut out to protect the apples. W. Paddock, of the Colorado Station, has shown that this disease also attacks the apricot. On the Pacific coast the disease continues to spread, but it was not so severe this season. It is reported from New Mexico. Twig blight, due to the same organism, was serious on apples in Connecticut, New York, Ohio, West Virginia, and Wisconsin, but was less prevalent in Missouri.

There was an epidemic of pear-leaf blight (*Entomosporium maculatum*) that was more severe on Kieffers and Le Contes than ever known, as these varieties have heretofore been resistant. It defoliated trees from Maryland southward by August 15, leading to much fall blooming. This fungus attacked quinces as usual. In Ohio quince black-rot (*Sphæropsis malorum*) was reported as occurring on both leaves and fruit, but it was successfully controlled by spraying. In Connecticut quinces were injured more than usual by pear blight.

In Massachusetts, Connecticut, and New York pears and cherries were much disfigured by sooty mold (*Fumago vagans*), which followed a serious epidemic of the pear psylla and apple louse.

PEACHES AND OTHER STONE FRUITS.

Brown-rot was again less injurious in the Eastern States, but was very destructive to southern peaches, the loss amounting to from 35 to 60 per cent of the crop in Georgia. The *Sclerotinia* stage appeared in abundance in Maryland at blossoming time. Plums and cherries were damaged more by this disease. Peach yellows prevailed as usual, but in Michigan in a rather mild form. Little-peach in Michigan was about as severe as before and is spreading rapidly. Peach-leaf curl seems to cause immense losses each year in spite of the ease of controlling it by a single spraying. In Ohio the loss was complete on such varieties as Elberta, Hills Chili, and Chairs Choice when unsprayed. In Ottawa County alone the loss from leaf curl was $50,000. The losses in northwestern Pennsylvania and western New York were also heavy. In California the disease prevailed where preventive spraying was neglected. Many growers saved their entire crops by giving a single spraying, while their neighbors who did not spray lost everything.

Peach scab (*Cladosporium carpophilum*) was very injurious in Connecticut, New York, Pennsylvania, and Ohio, though in Ohio the loss was only one-fourth that of last year and was partially controlled by spraying.

Powdery mildew (*Sphærotheca pannosa*) was more abundant in New York than for five years. In California and North Carolina the split-pit disease of the peach was more troublesome than usual.

The cherry shot-hole fungus (*Cylindrosporium padi*) was injurious in New York and Pennsylvania, and prevailed in a more destructive form than ever before in Iowa and Nebraska, where trees were early defoliated. The loss to one nursery company in Nebraska was $40,000. It was too wet to spray. In plum orchards in many cases even old trees were killed.

Crown gall is becoming more serious every year as a nursery pest throughout the country. Losses of 50 per cent or more are reported by nurserymen.

SMALL FRUITS.

The black-rot of the grape was apparently more general in Connecticut and Rhode Island than last year, the loss being estimated at 40 per cent. It was prevalent in many vineyards in western New York and in Erie County, Pa., causing a loss of 30 per cent of the crop, as compared with 40 to 50 per cent last year. North Carolina, West Virginia, and Ohio suffered severely, but in Ohio spraying was quite generally practiced, with good results. Reports from New York, New Jersey, Pennsylvania, and Michigan show that the downy mildew (*Plasmopora viticola*) was prevalent and injurious, but not so much as last year. In Nebraska grape rots of various kinds caused great loss, but much less than last year. The California vine disease has lost some of its severity in southern California and the Sacramento Valley, but is quite active in the Santa Clara Valley. The loss in 1903 has been moderate. This Department is obtaining promising results in its efforts to discover a resistant vine.

Strawberry leaf-blight seems to be less prevalent than formerly, though doing much damage to some varieties.

Raspberry and blackberry anthracnose probably occurred about as usual. It was reported from New York, Ohio, Michigan, Wisconsin, Missouri, and South Carolina. Cane blight (*Coniothyrium*) was reported of general distribution in Massachusetts, New York, Ohio, and Michigan. *Sphærella rubina* caused serious blighting of canes in Connecticut, though not considered harmful in New York. Crown gall was abundant and destructive on raspberries in Tompkins County, N. Y., while rust and leaf-blight probably occurred as usual.

Currant-leaf spot (*Septoria ribis*) was destructive in New York and Michigan and especially bad in Iowa, where it early defoliated gooseberries and black currants, while red currants were badly affected by *Cercospora angulata*. Leaf-spot was found to a limited extent as far west as Montana, but the principal enemy in Montana, Washington, and other Northwestern States is the gooseberry mildew (*Sphærotheca mors-uvae*), which practically prohibits the culture of the English varieties unless sprayed. Cranberry diseases occurred about as usual. The so-called scald has been shown by C. L. Shear, of this Department, to be due to several fungi, and his experiments indicate that it can be controlled by spraying with Bordeaux mixture.

SUBTROPICAL FRUITS.

Among the diseases of citrous fruits in Florida, die-back now causes only a fraction of the injury it did before 1896, owing to the use of Bordeaux mixture and to a better understanding of the harmful effects of fertilizing with organic nitrogen and cultivating in the rainy season. Wither-tip (*Colletotrichum glœosporioides*) is present in nearly all citrous groves in Florida, Mississippi, and Louisiana, and is rapidly increasing in severity. The estimated loss in 1903 was $50,000. P. H. Rolfs, of this Department, has determined the cause, and recommends cutting out diseased twigs, spraying with Bordeaux mixture, and an increase of potash and phosphoric acid in the fertilizer. Blight was less severe in 1903, owing to weather conditions and the practice of cutting out. Foot-rot, once considered the most destructive disease of citrous fruits, now does very little harm.

Pineapple wilt (*Fusarium*) and rootknot, due to nematodes, occur throughout the pineapple belt and cause large local losses.

Olive dry-rot, a disease not yet understood, is of general and increasing occurrence in California.

POTATOES.

The late blight of the potato (*Phytophthora infestans*) prevailed over the northern part of the country. Through a succession of unfavorable seasons and consequent increase in the infection of seed tubers this disease has been gaining headway for four years, and was, on the whole, more widespread and destructive this season than last. In the New England States the fungus appeared early and killed the tops, but a dry fall lessened the usual loss from rot, especially in Maine. In New York, Pennsylvania, northeastern Ohio, Michigan, and Wisconsin the loss from blight and rot was enormous. An accurate estimate by Stewart, of the New York Station, showed that the average loss was 50 bushels per acre, amounting in New York alone to $10,000,000 for that season, all of which could have been prevented by spraying. The disease extended beyond its usual range, being destructive in New Jersey and Maryland and southward to Norfolk, Va., and Hastings, Fla., while in the West it appeared in central Iowa for the first time in years; it also occurred west of the Cascade Mountains in Washington and Oregon. The distribution of the disease in 1903 is shown on the map in figure 53. An important addition to our knowledge has been made by L. R. Jones,

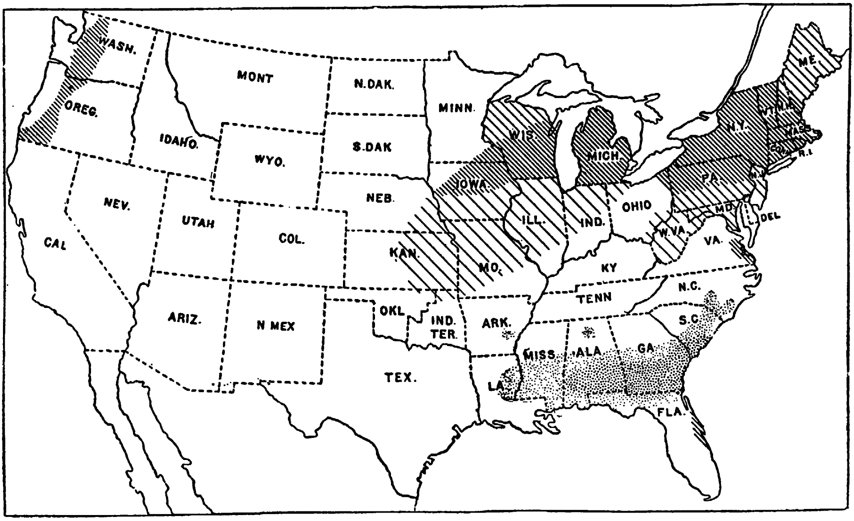


FIG. 53.—Distribution of late blight of potato (*Phytophthora infestans*) indicated by lines, and of cotton wilt (*Neocosmospora vasinfecta*), indicated by dots.

of the Vermont Station, relative to the effect of the date of digging on the development of rot in the tubers during storage. He finds that it is best to defer digging as long as possible. Of potatoes dug when leaves were half blighted (August 31) 55 per cent were rotted when dug or rotted afterwards, whereas in all cases where the tubers were undisturbed until the stalks had been dead ten days or longer only about 7 per cent of rot was found at digging time or thereafter. Early blight (*Alternaria solani*) was not as severe as usual in the North, but caused considerable loss to both spring and fall crops in Norfolk, Va., and southward. Stem-rot or rosette (*Rhizoctonia*) was prevalent in Florida and South Carolina to some extent. In Ohio the loss equaled that from rot. It has been carefully studied by A. D. Selby at the Ohio Station, who finds that seed treatment with formalin greatly increased the yield. A long rotation of crops is also advised to free the soil of the fungus. In Colorado and Wyoming this disease continues so destructive that the areas where potatoes can be grown are very limited, and even where the crop is successful the loss is about 25 per cent. F. M. Rolfs, of the Colorado Station, has found what appears to be the fruiting stage of this fungus (*Corticium vagum* B. & C. var. *solani* Burt). A stem rot of potatoes is also reported from California. The dry rot of potatoes is widespread throughout the country, but the amount of loss is not known. This disease has been carefully studied by E. F. Smith and D. B. Swingle, of this Department, and the cause found to be *Fusarium oxysporum* Schl.

TOMATOES.

Tomato bacterial wilt was found this year in Connecticut for the first time. This disease was serious in New Jersey and Maryland and widespread in the Southern States. The *Fusarium* wilt in Florida caused a loss of $500,000, and in addition large areas of land had to be thrown out of cultivation, as the disease prevents the planting of tomatoes more than one year on the same land. Leaf-mold (*Alternaria solani*) was widespread in Florida, but was usually controlled by spraying. Leaf-spot (*Septoria lycopersici*) occurred as usual in New England. The damage was small and less than last year in Ohio, but serious loss was reported from New York, New Jersey, and Missouri. Scab (*Cladosporium fulvum*) was reported injurious in greenhouses in Maryland and Ohio and outdoors in Ohio. Rosette, caused by *Rhizoctonia*, was found on tomatoes following potatoes in Ohio. In Maryland, sun-scald injured early tomatoes on the Eastern Shore. Apple bitter-rot (*Glomerella rufomaculans*) was common on late tomatoes in Michigan, and inoculations between apples and tomatoes were readily made. An undetermined tomato disease caused much loss in New Mexico, in the San Joaquin Valley in California, and in Washington.

Eggplant in Connecticut suffered from leaf-spot (*Phyllosticta hortorum*), which caused the fruit to rot badly.

CUCUMBERS AND OTHER TRUCK CROPS.

Cucumber downy mildew caused large losses in Florida and the trucking section near Charleston, S. C., where the estimated loss was $100,000. It was also unusually destructive in West Virginia, Pennsylvania, New York, and Michigan. It appeared later and did less damage than usual in Ohio. In Massachusetts, Connecticut, and Rhode Island the downy mildew, in connection with anthracnose and *Alternaria*, has made the culture of cucumbers and melons nearly impossible. The losses ranged from 65 per cent to 100 per cent of the crop. Anthracnose (*Colletotrichum lagenarium*) was more injurious than last year from New Jersey to Connecticut. Wilt (*Bacillus tracheiphilus*) was more abundant this year in Connecticut, Maryland, Madison County, N. Y., and Michigan. Scab (*Cladosporium cucumerinum*) was troublesome on both cucumber and muskmelon in Connecticut. A new mosaic disease of cucumbers was observed in forcing-houses in Ashtabula, Ohio. Cantaloupe leaf-blight (*Alternaria*) was injurious, especially in the South. The loss in Florida was nearly 40 per cent.

Watermelon wilt continues to spread in the South. The loss was especially severe this season in North Carolina, where the growers have not learned to avoid old land and stable manure. Anthracnose was very destructive from New Jersey to Connecticut.

Asparagus rust was much less destructive than heretofore in all the Eastern and Southern States. On Long Island many fields were free from it. The epidemic is still increasing in the West. It was very destructive in Nebraska, and has spread rapidly in California as far north as Sacramento. Important canning districts are badly affected.

Cabbage black-rot was uncommon in New York, but was seriously injurious in Michigan and in Ohio. It also occurred through the Southern States. Club-root seems to be spreading. Complaints to that effect came this year from Vermont, Connecticut, Erie County, N. Y., Ohio, West Virginia, Maryland, and North Carolina. Damping-off of cabbage and cauliflower was the only disease reported from Alaska.

Onion stem-rot (*Botrytis vulgaris*) was nearly as injurious in Connecticut as last year. Mildew (*Peronospora schleideniana*) caused unusual loss in Vermont, western New York, and in the seed farms of California. Smut (*Urocystis cepulæ*) continues to prevail on infected land in Ohio, but is successfully controlled when the formalin treatment is used.

Celery blight has not been severe this year, and the losses were small. Lettuce on the Atlantic coast from Florida to Virginia has suffered greatly from rot (*Botrytis cinerea*). It can be partially controlled by preventive measures, but often destroys from 30 to 70 per cent of the crops in 90 per cent of the fields. Lettuce in Ohio is attacked by *Rhizoctonia*, and soil sterilization is required as a remedy. Downy mildew (*Bremia lactucæ*) was reported bad in Erie County, N. Y.

Bean anthracnose (*Colletotrichum lindemuthianum*) caused much injury in western New York. Treatment with Bordeaux mixture was successful here. This disease did limited injury in Ohio, Michigan, and other States. Rust (*Uromyces appendiculatus*) and leaf spot (*Phyllosticta phaseolina*) contributed to the injury of the bean crop in New York. Blight (*Pseudomonas phaseoli*) and mildew (*Phytophthora

phaseoli) were particularly bad in Connecticut, New Jersey, and Delaware. Beans around St. Louis, Mo., were found by George G. Hedgcock, of this Department, to be injured by *Rhizoctonia*, which penetrated the seed, where it remained dormant, thus spreading the disease.

Field peas were seriously blighted in Ohio from some unknown cause. Powdery mildew (*Erysiphe*) was injurious in Ohio and Montana.

Endive rust (*Puccinia endivæ*) was found for the first time in Connecticut, probably having been imported from Italy.

Sweet potatoes were seriously injured by black-rot (*Ceratocystis fimbriata*) in Gallia County, Ohio. A black-rot was also reported from Merced County, Cal., and a soft rot from New Jersey.

Ginseng in New York and other States is becoming much subject to disease, as its culture is extended. Eight distinct diseases were observed last season.

SUGAR BEETS, FLAX, AND TOBACCO.

Sugar-beet leaf-spot (*Cercospora beticola*) began later and was not as prevalent as last year in the Eastern States. *Rhizoctonia* did comparatively little damage. Curly-top prevailed in the West about as heretofore.

Flax wilt (*Fusarium lini*) continues to be injurious in North Dakota and other flax-growing States, where it compels rotation with other crops. H. L. Bolley, of the North Dakota station, has found that it can be partially checked by disinfection of the seed, and his preliminary experiments indicate that it will be possible to develop resistant varieties by selection.

Tobacco mosaic disease was prevalent in Kentucky on about 25 per cent of the crop; also in Ohio, and to about the usual extent in Connecticut. Frog-eye (*Cercospora nicotianiæ*) developed in South Carolina late in the season, with small loss. Ring-spot occurred in Prince Edward County, Va. A seedling rot of doubtful cause gave considerable trouble in Connecticut, and a new disease—wilt—aroused much attention in Granville County, N. C. Where it occurred, 80 per cent of the plants were killed and the value of land depreciated from $18 to $7 per acre. Root-rot, due to *Thielavia basicola*, was reported from Ohio, where it makes it necessary to select new land for seed beds. Brown-rape (*Orobanche ramosa*) was injurious in Kentucky and in a small area in Claremont County, Ohio.

CEREALS AND FORAGE CROPS.

Wheat rust was rather worse than usual in the Northwestern States and in central Kansas, where the resistant emmer and spelt rusted badly. The loss in southern Wisconsin was estimated at 50 per cent and in South Carolina at 30 per cent. Wheat smuts were injurious throughout the West when seed was untreated, the loss being 10 to 50 per cent in such cases. Loose smut was abundant on spring wheat in western Nebraska, but not on winter wheat in eastern Nebraska. Wheat scab (*Fusarium*) was very bad in Nebraska and Ohio, where it caused two or three times the usual injury. Oats rust was common in New York, Michigan, Wisconsin, and Nebraska. It was particularly severe in South Carolina and adjacent States, where the loss was estimated at 50 per cent of the crop. Oats smut was bad in New York, Ohio, and throughout the West where seed was untreated. There is a great increase in the use of the formaldehyde seed treatment, particularly in North Dakota and Wisconsin. R. A. Moore finds that the average percentage of loss from oats smut in Wisconsin has been reduced from 17 to 7 per cent of the crop as a result of information disseminated by the station.

Corn smut is reported to affect one-third of the crop in Maryland, and to be common in New York, but less prevalent in Ohio, Michigan, and Nebraska. Corn-leaf-blight (*Helminthosporium inconspicuum*) was very general and injurious in Connecticut, Delaware, eastern Pennsylvania, and New Jersey, where 50 to 75 per cent of some corn fields were ruined.

Rice blast was severe in the Cooper River section of South Carolina, where the crop was over 100,000 bushels short this season. The loss from the spread of this disease in the past six years is estimated at one million dollars.

Cowpeas in the Southern States were injured by root-knot and wilt about as usual. The Iron cowpea continues to resist both these diseases and was also free from rust (*Uromyces phaseoli*), which greatly injured other varieties in Indiana.

Alfalfa rust (*Pseudopeziza medicaginis*) aroused complaint in Ohio, where it completely prevents the growing of seed, and from South Carolina, where it discourages experimentation with this crop, which is just being introduced. Alfalfa in Texas, Arizona, and New Mexico was injured by root-rot. Injury from dodder (*Cuscuta

arvensis and *C. trifolii*) was serious in New York and Ohio. Comment was caused by the prevalence of clover leaf-spot (*Phyllachora trifolii* and *Macrosporium sarcinæformæ*) in Connecticut and New York, anthracnose (*Glœosporium trifolii*) in Michigan, and rust (*Uromyces trifolii*) in New York and Michigan. Leaf-spot in South Carolina discouraged the introduction of clover. Dodder (*Cuscuta epithymum*) injured clover in Vermont and Ohio.

COTTON.

Anthracnose has been generally prevalent from North Carolina to Georgia, and locally injurious, especially to Sea-Island cotton in South Georgia. Wilt continues to spread slowly and now occurs in limited areas in North Carolina and South Carolina, and is widely prevalent in South Georgia and southeastern Alabama, in connection with root-knot. The distribution of cotton wilt is shown on the map in fig. 53, p. 552. Rust occurred as usual on the poorer soils and was unusually severe in Texas. The cotton root-rot in Texas prevailed to a greater extent than for many years. The loss is estimated at about $2,000,000.

NUTS, AND FOREST AND SHADE TREES.

Walnut bacteriosis (*Pseudomonas juglandis*) has caused heavy losses in California during 1903. Its distribution is now coextensive with the leading walnut centers of the coast. A reduction in loss of one-half through spraying has been obtained in the Department experiments.

Pecan scab (*Fasicladium effusum*) was unusually injurious on the nuts in orchards and on leaves of nursery stock in South Carolina, Georgia, and adjacent States. Rosette, an undescribed pecan disease, is very injurious in the same section.

Many Lombardy poplars in south Michigan are dying from some unknown cause. Sycamore blight (*Glœosporium nervisequum*) nearly defoliated trees all over California and was worse than usual in New York. Leaf-spot of horse chestnuts (*Phyllosticta*) was remarkably absent in New York, where it was abundant the year before, but was reported common in Massachusetts. Other fungi reported as common in New York were *Marsonia juglandis* on butternut and black walnut, and *Marsonia ochroleuca* on chestnut, *Dothidea ulmea* on elm, and *Melampsora populina* on poplar.

GREENHOUSE AND ORNAMENTAL PLANTS.

Carnation stem rot (mainly *Fusarium*) has been unusually prevalent the past season in the Eastern States. A new bacterial leaf-spot has been discovered by A. F. Woods, of this Department. Other diseases, such as rust (*Uromyces caryophyllinus*), leaf-spot (*Septoria dianthi*), and leaf-mold (*Heterosporium echinulatum*), aroused complaint in some instances. Violets have been injured by *Alternaria violæ* and by *Botrytis*.

Hollyhock rust was serious in Connecticut, New York, and Michigan. Rose diseases were troublesome in California, particularly powdery mildew and rust (*Phragmidium*). English ivy in Massachusetts was affected by *Vermicularia trichella*.

The bacterial blight of geranium was common in Massachusetts, and is spreading through the country.

PLANT DISEASES IN OUR ISLAND POSSESSIONS.

The coffee leaf-blight (*Hemileia vastatrix*) has accidentally been introduced into Porto Rico, but measures are being taken to stamp it out. The American coffee disease (*Stilbum flavidum*) is apparently of very local occurrence thus far. Cocoa is affected by a black pod-rot, canker, and a root disease.

The tomato blight (*Bacillus solanacearum*) has practically ruined the tomato crop of Porto Rico. A potato root-rot has caused the loss of nearly the entire potato crop.

Orange scab has caused considerable damage in the Bayamon district.

Beans and cowpeas are injured by various fungi. The potato dry-rot (*Fusarium*) continues injurious in the Hawaiian Islands.

PROGRESS OF FRUIT GROWING IN 1903.

By W. H. Ragan, *Special Pomological Agent.*

A barrel famine at gathering time, with greatly increased prices of all kinds of packages, seriously affected the pecuniary interest of apple growers throughout the country. Many apples were lost on account of the scarcity and high prices of barrels,

or were necessarily shipped in bulk, and therefore reached their destination in bad condition, in either of which cases the growers suffered serious losses.

An intelligent New England fruit grower reports a largely increasing interest in apple growing in that section, mainly for the export markets. The Baldwin is still the leading variety. One orchard just planted in New Hampshire has 7,000 trees, almost exclusively of the above-named variety, and a similar one of 10,000 trees is being planted in Connecticut. Next to the Baldwin the Rhode Island *Greening* is probably the most popular market variety in the New England States.

The fruiting of a large number of carefully grown seedling apples by Mrs. T. E. Perkins, of Minnesota, greatly encourages apple growers in that section. Hon. Wymann Elliott, of Minneapolis, exhibited 109 varieties of Mrs. Perkins's seedlings at the meeting of the American Pomlogical Society in Boston in September last, where they attracted deserved attention. The mother parent of the collection of seedlings was Malinda, a hardy Vermont variety, that seems to impart extraordinary hardihood of tree and beautiful coloring and fair quality of fruit to a large per cent of its offspring.

Under date of November 9, 1903, a prominent Georgia peach grower wrote:

> In Georgia there has been a very great increase in peach planting, not only in the old-established regions southwest of Macon, but also in the mountain districts of the northern part of the State. It is estimated that more than 3,000,000 trees were put out last winter, and as many more will go out this winter. Very much of this planting is being done by town people, merchants, and professional men who have but very little practical horticultural knowledge, and they are planting much more extensively than their knowledge warrants.

This grower inclines to predict the overdoing of the peach industry in the near future. He considers this danger most imminent in the great peach-growing sections of the South, where the Elberta is well known to have won fortunes for a few skillful growers. Fortunes are sometimes lost where the novice attempts to accomplish what an expert may have succeeded in doing. He further says: "In fighting San Jose scale in the South several hundred thousand peach trees were killed with oil, owing to the irregular working of the pumps and the work being done in unseasonable weather. In my own orchard, where the same oil and style of pumps were used, we had no damage whatever." This should be accepted by the inexperienced beginner as a further warning against proceeding without some practical knowledge.

There is no doubt of the efficiency of insecticides and fungicides, if intelligently and properly applied, but their use must not be intrusted to the ignorant and uninformed. Just as well expect safety and good results to human or animal life through the careless use of medicines as to apply poisons and other dangerous agents to our orchard and garden treasures without knowledge, skill, or experience in their uses and effects. And yet there is a great deal of such work now going on throughout the country.

An important measure was adopted by the American Pomological Society at its biennial meeting in Boston in September, that will enable originators of new fruits better to place them in competition for the Wilder medals of the society. The plan consists in the appointment of an ad interim committee, to be composed of experts in the several classes of fruits, to which specimens may be sent at any time between meetings, and whose tests, if favorably reported, will bind the society. These tests will be favorably reported to the society while in session, and the awards will be made or rejected in accordance with the character of the reports. This plan will doubtless greatly encourage and stimulate originators in their work of producing new and better fruits. A California exchange has the following favorable comments:

> Hitherto it has been possible for competitors to show only such varieties at the annual competitions as may ripen and be in prime condition at the time when the meeting is held. This has shut out a vast number of meritorious productions. For instance, only one or two of the remarkable achievements of Luther Burbank, of California, in the way of new hybridized fruits, some of which have made quick fortunes for nurserymen and orchardists, have been shown at the annual meetings, the long distance and the climate of California not permitting his work to be entered in competition. The ad interim plan will permit any investigator to have his work examined by a committee of experts at the time when his fruit is in the best condition to show it.

The California orange crop of 1903 reached a total of 32,000 cars of 360 boxes each, against 24,000 cars in 1902. Lemon shipments reached 3,850 cars of 312 boxes each.

Greatly increasing interest is being manifested in nut culture. Individual and organized efforts are being devoted to the work of producing nuts on a large scale. In California the Persian walnuts and almonds are the leading classes. In the Gulf States and the lower Mississippi Valley the pecan is first in importance. In the hill and mountain regions of the East, the chestnut in its different varieties and species takes the lead, while the shellbark hickory and native black walnut and butternut will doubtless later receive due attention in various sections.

PROGRESS IN FORESTRY IN 1903.

The largest fact of the year 1903 in the field of forestry was the progress made in public sentiment concerning it. In the East forestry became for the first time a live question in the minds of the great body of lumbermen. In the West public opinion underwent remarkable changes, which were shown particularly in the growth of feeling in favor of the national forest reserves, and in public appreciation of their intimate connection with the irrigation movement. When forest reserves were first created local interests were almost uniformly opposed to them. This opposition was based upon a misunderstanding of the objects for which the reserves were created, and their effect upon the productive interests of the regions in which they lay. A better understanding of the purposes of the Government has been followed by an almost complete reversal of the public attitude, so that now the opposition is practically at an end, except in isolated cases where rightly or wrongly the public interest is supposed to require the sacrifice of personal interests; otherwise throughout the West the great body of public sentiment is vigorously in support of the Government forest policy, the object of which, as President Roosevelt has stated, is the use of all the resources of the reserves so as to make them permanent.

Other evidences of a growing public interest in forestry are the attention given to this subject by the legislatures of the various States, the increased membership in the American Forestry Association, the organization of State associations, and the large attendance at forest schools.

FORESTRY ON PUBLIC LANDS.

The most important work of the year in forestry on the lands of the National Government has been that of the Bureau of Forestry in ascertaining necessary changes in the boundaries of existing National forest reserves and areas suitable for new reserves.

When the first reserves were created, in 1891, information about the areas set aside was in many cases very slight. As a consequence, the boundaries generally had to be roughly drawn, without special reference to the character of the land. It was only known that in certain regions the vacant public lands were covered by forest growth, and reserves were created to include these forests. Mistakes in the boundaries were, therefore, frequent; open lands, agricultural lands, and other lands not suited to purposes of forest reserves were sometimes included, while considerable areas of timber land were left out altogether. As exact knowledge of the regions is obtained, the boundaries are changed so as to secure the best use of all the land by reserving for timber and water supply only such lands as are more valuable for these than for other purposes. This is an aid, not a hindrance, to the development of the surrounding country, and as this fact is made apparent and justice is done to the legitimate claims of those who felt their interests injured by the first establishment of the reserves, the opposition has rapidly disappeared.

The work of examining lands for new forest reserves is now undertaken for the most part by the Bureau of Forestry, and is done with the greatest detail. During the summer of 1903 over 50,000,000 acres in the Rocky Mountain and Pacific Coast States were examined and mapped. Reports on this work are submitted to the Secretary of the Interior, with definite recommendations as to what areas should be reserved by the National Government.

Valuable public land is now passing so rapidly into private ownership that within a very short time, unless action is taken to reserve in the public interest the lands which ought to provide permanent forests, the opportunity to do so on an extensive scale will be entirely lost. For this reason the work of examination for new reserves is of National and pressing importance. Without such expert work the best forests in the sparsely settled regions of the West would naturally fall into private hands before it had become manifest that the public interest demands its reservation.

EXTENT OF FOREST RESERVES AND NATIONAL PARKS.

The increase in the area of the forest reserves belonging to the National Government during 1903 was 2,932,729 acres. The total area reserved at the end of the year was 63,095,254 acres.

Seventeen national parks, situated in fifteen States and Territories, protect the forests on 3,654,825 acres, and 68,557 acres of woodland are included in eight military reservations.

FOREST MANAGEMENT ON PUBLIC LANDS.

In the direction of introducing actual forest management on public lands, the most considerable work of the year has been that in northern Minnesota. In 1902, 225,000 acres of pine land in northern Minnesota were set aside by Congress to form the Minnesota National Forest Reserve. On this land is one of the finest bodies of red and white pine still uncut. The proceeds from the sale of this timber belong to the Chippewa Indians. Plans for conservative lumbering have been prepared by the Bureau of Forestry, under which the Indians will receive as much for their timber rights as they did formerly under destructive lumbering, and at the same time provision is made for the renewal of the forest.

A working plan for the management of the 2,300 acres of timber at the West Point Military Reservation was completed during the past year, and has been adopted.

FORESTRY ON PRIVATE LANDS.

The introduction of practical forestry on private lands in this country continues to be for the most part supervised by the Bureau of Forestry, under its policy of cooperation with private owners, although some advance is beginning to be made toward the development of independent commercial forestry. It is much to be desired that the supervision of such work should pass into the hands of private foresters, since the prime purpose of the cooperative work of the Bureau is to furnish object lessons which shall bring about the general application of practical forestry by private owners to their own lands.

During the year six private forests, aggregating 100,300 acres, have been put under management under the supervision of the Bureau. Plans have been completed for the management of six tracts, containing in all 449,400 acres, in four States. Working plans are in preparation for timber tracts containing 1,416,000 acres. Wood lot studies have been made of 4,164 acres. The total area of private lands on which forest management was being practiced under the supervision of the Bureau in January, 1904, was 456,389 acres.

STUDIES OF THE FOREST AND FOREST PRODUCTS.

An important work in connection with forestry in the United States, which can be completed only after many years of study, is that of determining and mapping the forests of the entire country, including the composition, density, division into types, etc. Much information along this line has been furnished by the studies for proposed reserves already examined. Cooperative studies in Maine, New Hampshire, California, and Maryland, participated in by the Bureau of Forestry and the States mentioned, have added to the information of this character. Forest maps of California, New Hampshire, and Maryland are in preparation. Studies of forest distribution have been made in Maryland, Texas, Missouri, California, Ohio, Michigan, Iowa, and Montana.

The introduction by the Bureau of the "cup" system of collecting turpentine has revolutionized at one stroke the naval-stores industry of this country, by securing a greatly increased output with very much less injury to the trees. The conversion of the great bulk of the southern operators to the new system took place in 1903.

Studies by the Bureau of Forestry of commercial trees have been continued. Special investigations have been made of forest fires and forest insects; of forest replacement and reclamation of shifting sands; of methods of wood preservation; of dendro-chemical problems; and of the cedar shingle, basket willow, and maple sugar industries. The investigation of methods of wood preservation to lengthen the life of railroad ties promises to bring about great economies in the vast annual consumption of timber for this use.

One of the most important lines of work undertaken by the Bureau is an investigation of the mechanical properties of wood, to determine the strength and durability of the merchantable timbers of the United States. The solution of practical problems is the aim of this investigation.

FORESTRY AND FOREST LEGISLATION IN THE STATES.

Progress in forestry has been made by various States, especially Pennsylvania, California, and New Hampshire. New York leads in the reservation of State lands for forest purposes with 1,245,925 acres. Pennsylvania has, approximately, 304,776 acres; Michigan, 57,103 acres; California, 38,349 acres; Minnesota, 20,551 acres;

Massachusetts, 13,959 acres; while Wyoming, Wisconsin, Kansas, and Washington follow with smaller areas.

At the 1903 sessions of State legislatures there were many laws passed showing in particular an advance along the following lines: Establishment of State forestry boards; promulgation or amendment of laws to protect against forest fires; arrangement for investigations, in some instances in conjunction with the Bureau of Forestry, of State forests, in order to establish a sound, practical forest policy; and a tendency to place State forest matters in the hands of expert foresters. The following are the more important acts of 1903:

California.—Appropriation of $15,000, to be used with equal amount from United States in investigation of State forests by Bureau of Forestry (chap. 155).

Colorado.—Sheriff of each county made fire warden (chap. 83). Resolution asking United States to establish further forest reserves in that State (p. 540, Sess. Laws).

Connecticut.—Provision for tree wardens and deputies to oversee tree planting (chap. 83). State forester to sell timber from forest reserves, and buy land therefor at not more than $4 per acre (chap. 132).

Florida.—Prohibition of cutting or boxing trees on State lands (chap. 5259).

Hawaii.—Provision for forest reserves and administration thereof under direct charge of expert forester (act 44).

Idaho.—Arbor Day established (p. 215, Sess. Laws).

Illinois.—Resolution requesting Bureau of Forestry to investigate and report on Illinois forests (p. 359, Sess. Laws).

Indiana.—Law concerning a board of forestry and a State forester (chap. 44). Arbor Day established (chap. 96).

Maine.—Provision for forest commissioner, fire wardens, and fire laws (chap. 168). Defining timber and grass land (chap. 232).

Michigan.—Creation of a State forest reserve and provision for its management by a forest commissioner (No. 175). Law making it a felony to cut timber on State land (No. 210). Provision for fire-warden service and fighting of forest fires, and prevention of fires from engines (chap. 249).

Minnesota.—Provision for purchase of land for forest reserve (chap. 134). Bounty for tree planting (chap. 230). Complete forest and fire laws (chap. 363).

Nevada.—No coniferous trees to be cut below 12 inches in diameter (chap. 93).

New Hampshire.—Rebate of taxes for land planted with timber (chap. 124). Appropriation of $5,000 for use by Bureau of Forestry in investigating the State forests (chap. 139).

New Mexico.—Misdemeanor to destroy timber unlawfully on school sections (chap. 81).

New York.—Change of closed season for burning fallows, brush, etc. (chap. 186). Amendment of fire laws (chap. 442).

North Carolina.—Resolution favoring the establishment of Appalachian Forest Reserve by Congress (p. 1173, Public Laws). Resolution for State investigation of feasibility of establishing Appalachian Forest Reserve (p. 1181, Public Laws.) Repeal of an act prohibiting corporations from owning more than 300 acres of timber land (chap. 87). Misdemeanor to cut timber upon State lands without permission (chap. 272, sec. 5).

Pennsylvania.—Grant of power to forest officials to arrest without warrant (chap. 29). Provision for deputy forest commissioner at salary of $2,500 (chap. 59).

Tennessee.—Felony to cut timber unlawfully on State lands (chap. 444).

Utah.—Misdemeanor to cut timber unlawfully from State lands (chap. 101). Bounty on tree planting (chap. 122).

Washington.—Complete forest fire laws (chap. 114).

Wisconsin.—Provision for forest commission, with expert forester and complete forest law (chap. 450).

Wyoming.—Land commissioners to control timber sales and leases (chap. 78).

INTEREST OF LUMBERMEN AND MINE OWNERS.

Lumbermen generally have shown a marked increase of attention to forestry, and a considerable percentage of them are inquiring whether they can not profitably introduce forest management on their holdings. This is hopeful for forest preservation; for lumbermen have not failed to see the end of the timber supply, but they have not believed in the past, what they may now find out, that they could make management pay.

Southern lumbermen especially have availed themselves to a remarkable extent of the offer of cooperation which the Bureau of Forestry has made to private owners in the handling of their timber lands. It has taxed the resources of the Bureau to

respond to the many requests for advice. Detailed working plans for forest tracts belonging to private owners in the South were prepared for 1,350,000 acres, and preliminary visits of inspection were made upon ten large forest tracts. Increasing consideration has been given by the associations of lumbermen in the South to the practicability of forestry as a business investment.

An exceedingly important field has been opened to the Bureau by the application of eight companies which own large tracts of timber in the mining districts of West Virginia and Tennessee. The problem here is the necessity of maintaining the forest as a permanent source of supply of mining timbers, if the mines are to be most economically worked.

INTEREST OF RAILROADS IN FORESTRY.

Among the steady consumers of timber whose future needs must force them to take an active interest in the means by which a continued yield of timber may be insured are the railroads. There are now 203,132 miles of railroad track in this country, and the number of ties required merely for renewal amounts annually to something like 114,000,000. The increasing scarcity and the rise in price of ties has aroused widespread discussion concerning future supplies, and many of the great systems of the country have been led during the past year to consider seriously whether they can take any action to make provision for future needs. The great railroads are particularly interested in the problem of the preservation of timber, especially ties and bridge timbers, and extensive experiments have been undertaken by the Bureau of Forestry in cooperation with many roads, to determine the best methods for increasing the length of service of ties and bridge timbers, not alone by preservative treatment, but also by mechanical devices, such as tie plates, screw spikes, and dowels. Special attention has been given to the preservative treatment of low-grade timbers for ties, and the results have shown that when properly treated these timbers give excellent service in the track. With the introduction of mechanical devices to prevent wear under the rail the use of the soft-wood timbers will probably increase very rapidly.

FOREST FIRES.

The most disastrous forest fires in 1903 occurred in New York, Pennsylvania, and Maine, in May and June. As is usually the case, these fires took place within a few weeks, during the prevalence of unusual drought. In the Adirondack region of New York, which suffered most severely, 600,000 acres of forest land were burned, entailing an estimated loss of $3,500,000. The area burned in Maine is estimated at 275,000 acres, and the loss at over $1,000,000. In Pennsylvania the fires were more scattered. The losses, though difficult to estimate, were heavy. Other regions of the United States suffered from intermittent and not unusually heavy fires. All told, the forest-fire losses during the year probably exceeded $10,000,000.

FOREST SCHOOLS.

There has been a decided increase in the attendance at the Yale Forest School and the Biltmore Forest School in the past year. A graduate forest school was established during the year at Ann Arbor, Mich., as a part of the general department of literature, science, and the arts of the University of Michigan, and three undergraduate courses in forestry were instituted—at Harvard University, the University of Maine, and the University of Nebraska. In addition a large number of universities and colleges now give short courses upon this subject. The New York State College of Forestry, at Ithaca, N. Y., was discontinued through the veto by the governor of the clause in the State appropriation bill providing for its maintenance.

The admirable work of the Forestry Bureau in the Philippine Islands, under the direction of Capt. George P. Ahern, has been continued. The efficiency of the Bureau has been largely increased by reorganization along certain lines, and its growth continues to be rapid.

The people of Hawaii, through their board of agriculture and forestry, have manifested very keen interest in forestry and a realization of the forest problems which confront the Territory. The board of agriculture, upon the recommendation of the Bureau of Forestry, appointed Ralph S. Hosmer to be superintendent of forestry, and he has entered upon his work there.

AREAS SURVEYED AND MAPPED BY THE BUREAU OF SOILS.

The following statement shows the location and extent of soil surveys made up to December 31, 1903. Lithograph maps drawn on a scale of 1 mile to the inch, covering each area surveyed, indicate in colors the distribution of the various soil types. The accompanying sketch map (fig. 54) gives the location of these areas.

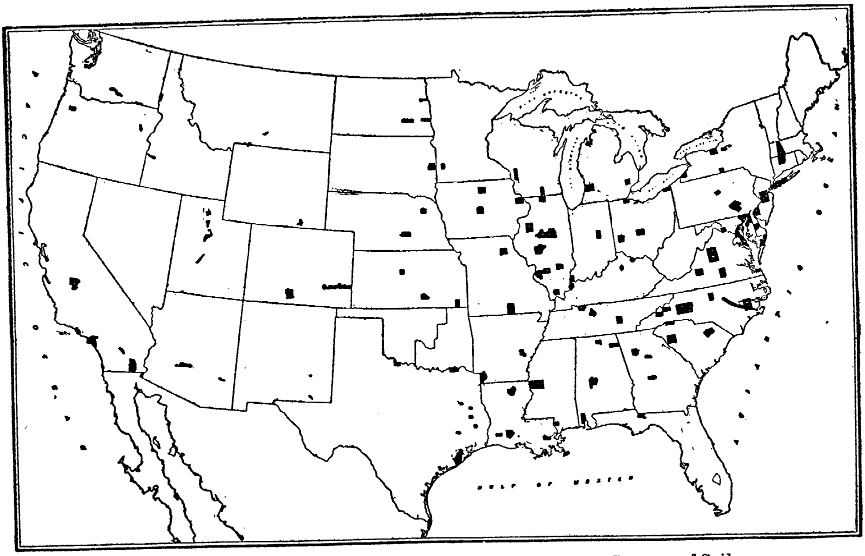


FIG. 54.—Location of areas surveyed and mapped by the Bureau of Soils.

The statement gives first the area surveyed for each minor division and then the total for the State or Territory:

Areas of soil surveys in the United States to December 31, 1903.

	Square miles.	
Alabama:		
Perry County	762	
Mobile area [a]	461	
Huntsville area [a]	506	
Fort Payne area [a]	509	
		2,238
Arizona:		
Tempe sheet	163	
Phoenix sheet	243	
Buckeye sheet	43	
Yuma area	99	
Solomonsville area [a]	108	
		656
Arkansas:		
Stuttgart area	251	
Miller County [a]	626	
		877
California:		
Fresno area	628	
Hanford area	216	
Imperial area [b]	1,084	
Salinas sheet	189	
San Gabriel area	259	
Santa Ana area	275	
Soledad sheet	155	
Ventura sheet	240	
Indio area [a]	234	
Los Angeles area [a]	570	
San Jose area [a]	313	
Sacramento area [a]	515	
		4,678
Colorado:		
Arkansas Valley area	945	
San Luis area [a]	628	
		1,573
Connecticut:		
Connecticut Valley [b]		505
Delaware:		
Dover area [a]		314
Florida:		
Gadsden County [b]		548
Georgia:		
Cobb County	346	
Covington area	225	
Fort Valley area [a]	186	
		757
Idaho:		
Boise sheet	155	
Caldwell sheet	244	
Lewiston area	308	
Blackfoot area [a]	428	
		1,135
Illinois:		
Clay County	460	
Clinton County	491	
St. Clair County	650	
Tazewell County	645	
Sangamon County [a]	866	
Knox County [a]	717	
Winnebago County [a]	526	
McLean County [a]	1,159	
Johnson County [a]	339	
		5,853

[a] Surveyed during 1903.

[b] Partly surveyed during 1903.

	Square miles.	
Indiana:		
Posey County	387	
Madison County [a]	435	
		822
Iowa:		
Dubuque area	440	
Story County [a]	576	
Cerro Gordo County [a]	567	
		1,583
Kansas:		
Wichita area	465	
Parsons area [a]	398	
Russell area [a]	270	
		1,133
Kentucky:		
Union County	361	
Scott County [a]	280	
Mason County [a]	225	
		866
Louisiana:		
Lake Charles area	202	
Ouachita Parish [a]	605	
New Orleans area [a]	410	
Acadia Parish [a]	636	
		1,853
Maryland:		
Calvert County	217	
Cecil County	376	
Harford County	418	
Kent County	293	
Prince George County	480	
St. Mary County	363	
Worcester County [a]	463	
		2,610
Massachusetts:		
Connecticut Valley [b]		809
Michigan:		
Allegan County	828	
Pontiac area [a]	307	
		1,135
Minnesota:		
Marshall area [a]		233
Mississippi:		
Yazoo sheet	463	
Mayersville sheet	193	
Smedes area	463	
McNeill area [a]	198	
		1,317
Missouri:		
Howell County	919	
Shelby County [a]	511	
		1,430
Montana:		
Billings area		107
Nebraska:		
Grand Island area [a]	446	
Stanton area [a]	323	
		769
New Jersey:		
Salem area	493	
Trenton area	810	
		1,303
New Mexico:		
Carlsbad sheet	80	
Roswell sheet	49	
		129
New York:		
Bigflats area	223	
Lyons area	515	
Westfield area	260	
Long Island area [a]	845	
Syracuse area [a]	416	
		2,259
North Carolina:		
Alamance County	365	
Cary sheet	63	
Clayton sheet	214	
Hickory area	988	
Kinston sheet	257	
Mount Mitchell sheet	497	

	Square miles.	
North Carolina—Continued.		
Newbern sheet	46	
Parmele area	236	
Princeton sheet	248	
Statesville area	781	
Craven area	897	
Asheville area [a]	497	
Saluda area [a]	190	
		5,282
North Dakota:		
Grand Forks area	314	
Fargo area [a]	406	
Jamestown area [a]	496	
		1,216
Ohio:		
Columbus area	472	
Montgomery County	480	
Toledo area	403	
Ashtabula area [a]	340	
		1,695
Oregon:		
Salem area [a]	284	
Baker City area [a]	158	
		442
Pennsylvania:		
Lancaster area	269	
Lebanon area	669	
Lockhaven area [a]	278	
		1,216
Porto Rico:		
Arecibo to Ponce		330
South Carolina:		
Abbeville area	1,006	
Darlington area	599	
Campobello area [a]	515	
Orangeburg area [a]	230	
		2,350
South Dakota:		
Brookings area [a]		484
Tennessee:		
Clarksville area	547	
Davidson County [a]	501	
Pikeville area [a]	440	
		1,488
Texas:		
Brazoria area	845	
Vernon area	277	
Willis area	215	
Paris area [a]	548	
Nacogdoches area [a]	97	
Woodville area [a]	100	
Lufkin area [a]	99	
Jacksonville area [a]	100	
		2,281
Utah:		
Salt Lake sheet	249	
Sevier Valley	235	
Weber County	310	
Provo area [a]	373	
		1,167
Virginia:		
Albemarle area	1,410	
Bedford area	632	
Prince Edward County	430	
Leesburg area [a]	419	
Norfolk area [a]	303	
		3,194
Washington:		
Sunnyside sheet	224	
Walla Walla area	201	
Yakima sheet	85	
		510
Wisconsin:		
Janesville area	451	
Viroqua area [a]	504	
		955
Wyoming:		
Laramie area [a]		309
Total		60,411

[a] Surveyed during 1903. [b] Partly surveyed during 1903.

THE PRINCIPAL INJURIOUS INSECTS OF 1903.

By F. H. Chittenden, *Entomologist in Charge of Breeding Experiments.*

The calendar year of 1903 resembled in many respects the two previous years as regards losses occasioned by insects; there was a similar decrease and, on the whole, evidence of smaller losses than have occurred in many years. In limited localities, however, certain pests did great injury. There were quite as many complaints of outbreaks, although not, as a rule, of great seriousness, and several new insect enemies of certain crops were detected. Among the most injurious pests the Mexican cotton boll-weevil has been the most remarkable, as it has not only continued its range in Texas but spread into Louisiana. The San Jose scale and codling moth, although not the subject of as much complaint as in earlier years, have engaged the attention of many economic workers, and there is a possibility of a lessening of damage in a few years. There were local outbreaks, usually not extensive, of the Hessian fly, chinch bug and of grasshoppers or locusts, cutworms, and army worms. Root-feeding species, such as white grubs, wireworms, root-maggots, and root-lice were, for some unknown reason, rampant over a considerable territory, many complaints of injury having been received. The cabbage and onion maggots were particularly destructive. The two cucumber beetles, orchard scale insects in general, and a few similar pests, were normally troublesome. On the other hand, bill-bugs as a whole did little damage, which is true of the bean and pea weevils, so far as reports are concerned. Shade-tree defoliators were only locally abundant. The gypsy and brown-tail moths have both enlarged their territory, the latter having become destructive in New Hampshire. The cherry fruit fly has apparently disappeared, owing to atmospheric conditions, and other pests, such as the squash bug, strawberry weevil, squash vine borer, the potato and tobacco weevils, have not attracted attention. Of insects injurious to stored products there has been a decided increase, especially of the cigarette and flour beetles. Several species of insects, as a rule more destructive in the South, but which have until recently been very troublesome northward, have nearly died out in the North in past years, the list including the harlequin cabbage bug, cabbage looper, corn stalk borers, fall army worm, and others. This, however, can not be said of all localities.

The apple Bucculatrix, or ribbed cocoon maker, had a very destructive period in the apple orchards of central New York, and was also in evidence in Pennsylvania.

The apple maggot (*Rhagoletis pomonella* Walsh) was unusually injurious in Ohio and New Hampshire, and many apples injured by this species in other regions were noticed on sale in the District of Columbia.

Apple plant-lice (*Aphis mali* et al.).—Considerable damage to apples by plant lice of different species was observed in New York, New Jersey, Ohio, Pennsylvania, Maryland, Connecticut, Nevada, and Washington. The woolly aphis (*Schizoneura lanigera* Hausm.) caused considerable injury during the year in various portions of New York, Ohio, and Virginia.

Bollworm (*Heliothis armiger* Hbn.).—Losses due to this species were reported throughout the cotton belt from North Carolina westward, also in southern Calfornia. Injury to cotton in Texas alone is estimated by Mr. A. L. Quaintance at $5,000,000. Adding the shortage on corn, tomato, tobacco, and various forage and garden vegetables in the same State, he estimated a total loss of $6,300,000. A correspondent in North Carolina estimated a loss of 16 per cent to cotton, one in California to sugar corn at 25 per cent, while in one region of Louisiana a complete loss of tomatoes was reported.

Canker-worms.—Both spring and autumn forms were destructive in Ohio.

Cigarette beetle (*Lasioderma serricorne* Fab.).—This beetle has been very troublesome for a number of years from Pennsylvania, District of Columbia, and Maryland southward, and has continued its ravages in tobacco in large warehouses and factories there, and has injured much tobacco and drugs in Florida and Virginia. In Maryland a tobacco manufacturer expended over $1,000 in an effort to eradicate the pest.

Common asparagus beetle (*Crioceris asparagi* Linn.).—Was reported 40 miles west of Chicago. It has continued to be diffused northward and westward.

Common elm borer (*Saperda tridentata* Ol.).—This borer, which has destroyed many trees in the vicinity of Cincinnati, Ohio, in years past, continues there as usual, and has been reported doing much damage also in Indiana and New York.

Cotton boll-weevil. (*See* Mexican cotton boll-weevil.)

Cotton leaf worm or cotton worm (*Alabama argillacea* Hbn.).—Was much complained of in Georgia.

COWPEA-POD WEEVIL (*Chalcodermus æneus* Boh.).—Was reported from numerous localities in the South as injuring cotton, but these reports were found to be erroneous, the insect having bred in cowpea and spread from that crop to cotton fields.

CUCUMBER FLEA-BEETLE (*Epitrix cucumeris* Harr.).—Great damage to Cuban tobacco grown in Connecticut and to ornamental petunias in Washington, D. C.

DESTRUCTIVE PINE BARK-BEETLE (*Dendroctonus frontalis* Zimm.).—After an absence of many years, when it had apparently disappeared, reappeared in Georgia, and if its increase continues will require prompt action to check its ravages and spread to uninfested regions.

ELM TWIG-GIRDLER (*Oberea ulmicola* Chttn.).—Was first described and its habits made known in 1904 as an enemy to the elm at Decatur, Ill., although its destructive work, which is made evident by the numerous dropping of leaves in May and June, was originally noticed in 1901.

FICKLE MIDGE (*Sciara inconstans* Fitch).—Continued its depredations in various localities. During the year it was reported most injurious in Pennsylvania and in Nevada.

FLOUR BEETLES (*Tribolium ferrugineum* and *confusum*).—Were the cause of much trouble in elevators, on board ships, and in freight and express trains, injury in most cases being to flour, and occurring from Minnesota to Louisiana and Texas.

FALSE CHINCH BUGS (*Nysius minutus*, *N. parallelus*, and *N. angustatus*).—Unusually destructive in the Western States and to a considerable variety of crops, including corn and other cereals, potato, sugar beet, cabbage, etc.

FRUIT-TREE BARK-BEETLE (*Scolytus rugulosus* Ratz.).—Although not more injurious than formerly, this pest was noted on numerous occasions in Maryland and Georgia attacking perfectly healthy trees, indicating that the insect has gradually assumed this habit, which, several years ago, was not believed possible.

FULLER'S ROSE BEETLE (*Aramigus fulleri* Horn).—Much damage in fields of strawberry and raspberry in southern California. Experiments with bisulphid of carbon against the larva were quite effective. Also injurious in Fredonia, Ohio.

GARDEN WEBWORM (*Loxostege similalis* Guen.).—Serious injury to young cotton in southwest and north Texas, in Oklahoma, and Louisiana, causing replanting in many instances.

GRAIN PLANT-LICE (*Nectarophora granaria* et al.).—Quite troublesome early in the season, but later were destroyed, mainly by parasites.

GRAPE BERRY MOTH (*Eudemis botrana* Schiff.).—Particularly destructive in Ohio.

GRAPE LEAF-HOPPERS.—Destructive for a number of years, and *Typhlocyba comes* has done considerable injury in New York State.

GRAPE ROOT-WORM (*Fidia viticida* Walsh).—Continued its ravages in the vineyards of northern Ohio and New York, including Long Island, and much experimental work has been done against it in those States.

GRASSHOPPERS OR LOCUSTS.—More especially *Camnula pellucida*, *Melanoplus atlanis* and *Aulocara elliotii*, were destructive in the Northern States and Territories west of the Mississippi River Valley.

HARLEQUIN CABBAGE BUG (*Murgantia histrionica* Hahn).—Not observed in injurious numbers in cultivated fields in or near the District of Columbia, but was found sparingly on wild crucifers. Southward it was about as numerous as ever.

HORNFLY.—Troublesome on cattle and other stock in Minnesota and in Canada.

HORSEFLIES.—These, with related flies, were injurious to stock, and made the subject of special study in Louisiana and Ohio.

LEAF-BEETLE (*Phædon æruginosa* Suffr.).—This beetle has assumed a new rôle as an enemy of water cress in Pennsylvania.

MEDITERRANEAN FLOUR MOTH (*Ephestia Kuehniella* Zell).—Has increased in mills in Minnesota.

MEXICAN COTTON BOLL-WEEVIL (*Anthonomus grandis* Boh.).—Has continued its destructive spread in Texas, and has even crossed into Louisiana. In the regions infested in Texas it has been estimated that 50 per cent of the cotton crop has been lost, a money value of $15,000,000. An appropriation of $250,000 has been made by Congress for immediate steps toward abating the further spread of this, the most important insect pest of the present time. See figure 10, page 206.

NEW YORK WEEVIL (*Ithycerus noveboracensis* Forst.).—This weevil, which has attracted considerable attention during recent years, has continued its depredations, more especially in Illinois, Indiana, Iowa, and Alabama. In some cases it ruined young apple orchards. It attacks the buds or axils of the leaf-stalks and sometimes gnaws the leaves.

NORTHERN MOLE CRICKET (*Gryllotalpa borealis* Burm.).—Reported devastating the potato crop about Richmond, Ky., also in Luzerne County, Pa.

NUT WEEVILS.—Considerable injury to chestnuts in Pennsylvania. *Balaninus proboscoideus* and *B. rectus* are the offenders and similar damage in Maryland and Virginia was noted. In the Southern States pecan nuts were more injured than hitherto, most noticeably in Texas and Georgia, and to a less extent in Mississippi. In one locality in Georgia 75 per cent of the crop was lost.

OYSTER-SHELL BARK-LOUSE (*Mytilaspis pomorum*=*Lepidosaphes ulmi*).—After a term of comparative innocuousness, this pest has attracted considerable attention in various portions of the country, especially in northern Ohio and Maryland.

PLANT-LICE.—Of these insects the strawberry root-louse (*Aphis forbesi* Weed) did considerable damage in Maryland. The melon louse (*Aphis gossypii* Glov.), although troublesome at times, was really rare during a great part of the season in a considerable portion of its range, from Maryland and the District of Columbia southward. Other species that were troublesome are the apple and grain plant-lice, which have already been mentioned, and the pea louse, which did local injury in Texas, South Carolina, Pennsylvania, and Rhode Island.

PEAR-TREE PSYLLA (*Psylla pyricola* Forst.).—Cause of excessive losses in many fruit-growing regions of New York, Rhode Island, and Canada.

PECAN BUDWORMS (*Acrobasis* spp.).—Injurious in the Gulf region.

PECAN HUSK WORM (*Enarmonia* (*Grapholitha*) *caryana* Fitch).—Particularly troublesome in Georgia. A Texas grower reports one of these insects more destructive to pecan than all other causes combined and causes losses of millions of dollars yearly.

PLUM CURCULIO.—Mr. M. V. Slingerland, of New York, reports that several growers made thorough tests of arsenate of lead, sometimes mixed with Bordeaux mixture, with gratifying results. The same combination has been much urged by the Division of Entomology during the past season for this and other insects, with hopes of its being more effective than Paris green, alone or combined with Bordeaux mixture.

PLUM LEAF SAW FLY (*Dimorphopteryx pinguis* Nort.).—Injurious in Canada.

QUINCE CURCULIO (*Conotrachelus cratægi* Walsh).—Continued injurious in New York.

STALK BORER (*Papaipema nitela* Guen.).—Injurious to various garden products in New England; also in Minnesota.

POWDER-POST BEETLES (*Lyctus* spp.).—More reports of damage to hardwood handles of agricultural implements and to wood to be used for this and similar purposes were received than in many previous years, the damage being most pronounced in Illinois, Indiana, Minnesota, Louisiana, Pennsylvania, Nebraska, Missouri, Iowa, Texas, Colorado, Wisconsin, Ohio, and Arkansas.

RED SPIDER (*Tetranychus bimaculatus* Harv.).—Injurious chiefly in greenhouses in many parts of the United States.

ROSE MIDGE (*Neocerata rhodophaga* Coq.).—Cause of serious loss in rose houses in Chicago, Ill., injury being most pronounced on the Meteor variety, as in earlier years. Similar damage was done in Cleveland, Ohio, evidently by the same species.

ROSE-CHAFER (*Macrodactylus subspinosus* Fab.).—Unusually numerous in 1903 in several localities in New York.

ROOT-MAGGOTS.—The year 1903 has been marked by unusual injuries by the imported cabbage maggot (*Pegomya brassicæ* Bouché), the onion maggot (*Pegomya cepetorum* Meade), and other species of less importance. The cabbage maggot has been very troublesome in New York, Pennsylvania, and Canada; the onion maggot in Michigan, New York, Maine, New Hampshire, and Canada. The carrot rust fly (*Psila rosæ* Fab.) has continued destructive in New York and in Canada, where it is permanently established, and the seed-corn maggot (*Pegomya fusciceps* Zett.) did considerable damage to several crops, including peanuts, in California. The probable reason why root-maggots are so destructive is that comparatively little is done by many owners to check them, failure to rotate with immune crops, and in some cases the persistent use of barnyard manure.

SAN JOSE SCALE (*Aspidiotus perniciosus* Comst.).—Although still the subject of much remedial experiment, this scale appears to be gradually attracting less attention year by year, partly due to its becoming better known as a pest and partly to the more general use of remedies; perhaps also to the fact that these remedies are having a material effect in reducing the number of this, one of our most troublesome of orchard pests.

SHADE-TREE DEFOLIATORS.—Our three most destructive shade-tree defoliators, the white-marked tussock moth, fall webworm, and elm leaf-beetle, were reported injurious in a few localities, but were, on the whole, much less destructive than in recent years.

SOUTHERN GRAIN LOUSE (*Toxoptera graminum* Rond.).—Noticed in early grain in Texas, but was evidently controlled by parasites. About the same time the insect was reported on oats near Hartsville, S. C.

STRAWBERRY CROWN-BORER (*Tyloderma fragariæ* Riley).—Associated with injury by the root-worms in the vicinity of Nashville, Tenn.

STRAWBERRY ROOT-WORMS (*Typophorus canellus, Graphops marcassitus* and *G. nebulosus*).—With other strawberry pests, these worms have been very destructive to extensive strawberry interests in the vicinity of Nashville, Tenn.

STRAWBERRY WEEVIL (*Anthonomus signatus* Say).—Caused considerable damage in Maryland and Minnesota.

SWEET-POTATO WEEVIL (*Cylas formicarius* Fab.).—Noted as having been the cause of the practical abandonment of sweet-potato growing in Texas. Injurious in Cuba.

THRIPS (different species).—These attracted considerable attention by their injuries to alfalfa in Colorado, to carnations in greenhouses in Ohio, and through their injuries in gardens in New York. The tobacco thrips (*Thrips tabaci* Lind.) was reported injurious in New York and in Barbados, West Indies.

TWELVE-SPOTTED CUCUMBER BEETLE (*Diabrotica 12-punctata* Ol.).—As troublesome during the year as at other times from the District of Columbia southward. At Washington it despoiled many garden flowers, especially canna, while roses and dahlias were nearly completely ruined. In Texas the insect occurred "by the million," eating everything, including maize and Kafir corn and garden plants.

"WHITE FLY" (*Aleurodes* spp.).—Many complaints of losses by Aleurodes were made during the year, especially in Pennsylvania, New Jersey, Illinois, Maryland, Mississippi, Ohio, Florida, the District of Columbia, Cuba, and Jamaica. Infestation of strawberry was unusually large.

WHITE GRUBS (*Lachnosterna* spp.) were more than usually injurious over a considerable territory to roots of valuable trees, such as seedling fruit trees, to corn, and to grasses on lawns. Injury was very pronounced in Minnesota by *L. rugosa*, in Virginia by *L. hirticula*, and in numerous other States, including Illinois, Wisconsin, Pennsylvania, Texas, Ohio, Michigan, Alabama, and Massachusetts, where the species could not be identified. A correspondent in Illinois reports perfect success in the use of bisulphid of carbon against this class of insects. Unless conditions which we do not understand are present, there is probability that an invasion of the May or June beetles (the parents of these insects) may follow these attacks in one or possibly two years.

PROGRESS IN BIRD AND GAME PROTECTION IN 1903.

By HENRY OLDYS, *Assistant, Biological Survey.*

The year of 1903 was one of great activity in the protection of game in the United States. Interest centered chiefly in legislation, the volume of which was greater than in any previous year, and many new laws were enacted increasing the restrictions already on the statute books and providing more effective enforcement. Several important cases were decided by the courts. The movement for the protection of nongame birds spread to a number of additional States, and an important agreement was made between the Audubon societies and leading wholesale millinery organizations. The importations of exotic species were numerous and afforded some features of special interest. New game preserves, some of notable size, were established, usually by sportsmen's clubs, but in one or two instances by hotels as an added attraction.

LEGISLATION.

Of forty States that considered game-law amendments in 1903, thirty-six passed more or less comprehensive measures. Virginia and Tennessee adopted general game laws, uniform in their application throughout the State and superseding previous conflicting county laws. Georgia, Idaho, Illinois, Minnesota, Nevada, Texas, Washington, and New Brunswick also enacted new general laws, or materially modified existing statutes. A few States added to their restrictions on trade in game: Arkansas, Minnesota, and Texas prohibited the sale of all game, Wisconsin of all but a few species, Utah and Oklahoma of big and upland game, and several other States of certain game birds; Virginia and Montana prohibited the export of any of their game, and Texas passed an important law prohibiting export of all game, including waterfowl, which had formerly been excepted. Nine States and Territories now prohibit the sale of all game, twenty-seven prohibit the sale of certain species, and only thirteen have no restrictions on sale. Prohibition of export of game in some form is in force practically throughout the country.

Among the changes in close seasons, it is noteworthy that New York and Montana cut off spring shooting of waterfowl; Nevada of ducks, woodcock, plover, and snipe; and Massachusetts of shore birds.

Several States adopted better means for the enforcement of laws. Tennessee provided a State warden, New Mexico a Territorial warden, and Georgia county wardens. North Dakota replaced its State warden with two district wardens. North Carolina authorized its newly organized Audubon society to appoint game wardens, and exercise general supervision over the protection of game and nongame birds in the State. The principle involved in thus committing the enforcement of game laws to a protective organization is not new; the Delaware Game Protective Association and the Nova Scotia Game and Fishery Protection Society exercise similar jurisdiction, and this method of enforcement is common in Australia.

A unique feature of the legislation of the year of interest to farmers consists of laws enacted by Maine and Massachusetts, making provision for compensation for damages done by deer to growing crops; and it will interest sportsmen to note that Minnesota has abolished the confiscation of dogs and guns, and that the requirement of photographs of hunters on nonresident licenses has been abandoned by Illinois and adopted by Indiana.

The subject of hunting licenses occupied much attention, which resulted in the adoption of nonresident licenses in eight States and resident licenses in four. Thirty-one States now license nonresidents and thirteen license residents. Maine, after considerable discussion, adopted a $15 nonresident license. Colorado, Idaho, New Hampshire, North Carolina, Tennessee, and Utah also established nonresident licenses, and Colorado, Idaho, Illinois, and Indiana adopted the resident license system. Pennsylvania passed a law requiring unnaturalized residents to secure $10 licenses before hunting. In Maine 1,697 nonresident licenses were issued during the season, yielding a revenue of $25,455; in Utah 30, yielding $300; and in Colorado 34, yielding $746; while in North Carolina the sale of nonresident licenses realized a fund of about $5,000, and in Illinois licenses, chiefly resident, added about $60,000 to the game fund. Wyoming raised the fee for its nonresident license from $40 to $50. On the other hand Newfoundland reduced the rate from $100 to $50, and West Virginia lowered its rate from $25 to $15 and made the license good throughout the State, instead of in a single county; while Washington, departing from all precedent, established a uniform fee of $1 for licenses without regard to the residence of the licensee. Tennessee provided that nonresidents shall pay the same fees required of nonresidents in their own States. This system was tried by New York and proved unsuccessful, and a somewhat similar experiment was abandoned by Minnesota.

The Alaska game law was supplemented by departmental regulations, which included a five years' close season for caribou and walrus, owing to a growing scarcity of these animals in certain parts of the Territory.

During the year nine States—Colorado, Georgia, North Carolina, North Dakota, Oregon, Tennessee, Texas, Virginia, and Washington—enacted the uniform law suggested by the American Ornithologists' Union for the protection of nongame birds; thus raising the number of States that have adopted this law to twenty-seven.

GAME LAW DECISIONS.

Several points of general interest were passed upon by the courts during the year. The provision of the recent Arkansas law prohibiting a nonresident owner of property in Arkansas from hunting on his own land, was held by the circuit court to be in conflict with the Constitution of the United States. In three cases laws were declared unconstitutional on account of technical defects in the title, thus showing the importance of exercising greater care in drawing bills. Notable examples are those of the new game law of Montana, which was declared unconstitutional by the supreme court of the State (State *v.* Brown, 74 Pac. Rep., 366); the license law of Washington, which was declared unconstitutional by the circuit court of Spokane County; and the act incorporating the Blooming Grove Park Association, passed by the Pennsylvania legislature in 1871, which was declared unconstitutional by the supreme court of the State (State *v.* Hazen, 56 Atlantic Rep., 263). The importance of this last decision lies in the limitations it places upon private game preserves, and the bearing it will have as a precedent in showing that neither corporate interests nor a claim of vested rights is likely to be upheld when in conflict with State laws. Mention should also be made of the case of State *v.* Salles, in New Orleans, in which possession of game out of season, although prohibited by the State law, was held by the court to be merely prima facie evidence of illegal killing and not an offense in itself. In the case of the Arctic Freezing Company of New York (People *v.* Bootman), which attracted much attention last year on account of the large penalty involved, the court of appeals passed on certain questions raised in the demurrer filed by the defendants, and reasserted the right of the State to legislate concerning imported game. In Wisconsin the question of the right of State officers to search

baggage in transit has been appealed to the supreme court of the State. A case involving the right to export birds taken on one's own land (State *v.* Van Pelt), appealed from the Michigan courts to the United States Supreme Court in 1902, was withdrawn. Its abandonment removes the only prospect for an early decision on a game law by the Supreme Court of the United States.

PROTECTION OF NONGAME BIRDS.

The effect of the more and more general adoption of the comprehensive measure suggested by the American Ornithologists' Union for the protection of nongame birds, and of the sentiment that supports it, is manifest in the decrease in the traffic in native song and bright-plumaged birds as pets. Although canaries and other foreign cage birds are imported by hundreds of thousands each year, so far as is known only about 1,000 native birds—mockingbirds, cardinals, and nonpareils—were exported during the year. The domestic trade has also been further restricted. The new law of Texas has cut off one large source of supply, and closer watch and more effective enforcement have made infractions of the various State laws more and more difficult.

Interest in the use of birds for millinery purposes has been largely focused on the activity of the State authorities in Ohio, and on the agreement entered into between two of the leading millinery associations and the Audubon societies of a number of States. In the effort to enforce the provisions of the Ohio law, seizures of millinery stock were made by deputy game wardens in Cleveland, Columbus, Toledo, and other cities. The agreement with the Audubon societies was made for the purpose of avoiding such conflicts and provides for the discontinuance for three years of the sale of several birds heretofore extensively used in the trade.

ORGANIZATIONS.

The important part played by voluntary organizations formed for the purpose of enforcing laws protecting game and nongame birds, renders the advent of new State associations of this kind a matter of general interest. During the year Audubon societies were organized in Colorado, Georgia, Michigan, North Dakota, and Texas, and a State game and fish protective association in Washington.

Mention should be made of the successful efforts of the game associations in New York, Oregon, Massachusetts, Tennessee, and Texas, in behalf of more effective laws; of the work of the Florida and North Carolina Audubon societies in enforcement; and of the protection committee of the American Ornithologists' Union in protecting the colonies of sea birds along the Atlantic coast, in patrolling the rookeries in southern Florida, and in taking steps to secure the cooperation of the Navy Department in averting the threatened extermination of the white terns on the Midway Islands, a station of the new Pacific Cable Company lying northwest of the Hawaiian Islands and belonging to the United States.[a]

IMPORTATIONS.

Several of the importations were of more than ordinary interest. The National Zoological Park received from Australia two echidnas, peculiar animals seldom brought to this country. The opening of the new antelope house at the New York Zoological Park was the occasion of the importation of several interesting species of antelopes rarely seen in captivity in this country, among which may be mentioned the addax, eland, Baker's antelope, and both the common and the white-tailed gnus. Four giraffes were imported during the year, making six of these rare animals now in the United States.

So far as known none of the prohibited species came into the country during the year. Two mongooses, received at Philadelphia from Jamaica, and one received at San Francisco from the Philippines, were killed; two flying foxes or fruit bats that arrived at San Francisco from Australia, were also destroyed, and fifty that were brought from Singapore to New York in one consignment were reshipped to Hamburg, Germany.

The New York forest, fish, and game commission liberated a number of elk in Adirondack Park, obtained from the game preserve of William C. Whitney. Seventy-three were set free at different points, raising the total number thus far

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[a] Auk, Vol. XXI, pp. 97–208, January, 1904.

placed in the park to 140. With the natural increase and allowing for deaths, it is estimated there are now about 170 elk in the Adirondacks. Three shipments of capercailzie from Sweden were entered at New York en route to the Algonquin National Park of Ontario, where the Ontario fish and game commission is attempting to acclimatize the species. About 2,000 eggs of game birds were imported during the year, under the act of June 3, 1902, and the importation of Chinese quail for restaurant purposes, so common at San Francisco, was reported from Honolulu, Hawaii, where several hundred were imported during the winter of 1902-3. Many pheasants for game preserves and aviaries continue to come across the border from Canadian pheasantries. State laws protecting imported pheasants are numerous, and Massachusetts is considering the introduction of mountain quail from the Pacific coast.

PRESERVES.

Private game preserves are constantly and rapidly increasing in number, and during the year several large tracts have been converted into hunting parks. Mention should be made of the lease of more than a hundred thousand acres of Biltmore, near Asheville, N. C., and the establishment of a 10,000-acre preserve on the Chickahominy River, in York County, Va., by a leading Virginia hotel. The latter preserve is interesting as an illustration of a new application of the principle of game preserves recently adopted by hotels, which seek by acquiring hunting tracts to afford added attractions to guests.

A departure in the establishment of national preserves was the setting aside of Pelican Island, Fla., in April, 1903, by the President as a reservation for the protection of native birds, and placing supervision thereof in the hands of the Department of Agriculture. This island, less than 4 acres in extent, is the breeding ground of a colony of 2,000 to 3,000 brown pelicans that, without such protection, were in danger of extermination. A warden has been appointed by the Department and cooperation continued with the American Ornithologists' Union, which had already undertaken the protection of the colony. The birds were practically undisturbed last season, and, under the care of the warden, enjoyed complete protection while they remained on the island during the breeding season.

RECENT ROAD LEGISLATION.

By M. O. Eldridge, *Assistant Director Office of Public Road Inquiries.*

Alabama.—Under the new constitution public roads are included with buildings and bridges as improvements, for which a special tax of 25 cents on the $100 may be levied in addition to the regular tax of 50 cents, out of which both bonds and interest had formerly to be paid. The recent legislature made this effective by passing a general law permitting counties to vote at any time for a bond issue and a special tax for roads.

California.—An appropriation of $25,000 was made to continue the work on the State roads. A law was enacted permitting supervisors to build or buy mountain roads out of the county general fund or general road fund when the cost thereof would be too great for the fund of the road district in which the road is to be located.

Connecticut.—The general law was amended to provide for the planting of trees along the State roads, to permit the purchase of two stone crushers for use in towns distant from railroads, and to permit the appointment of deputy commissioners. The appropriation was increased to $243,912.50 per year for two years. In the State of Connecticut the legislature had appropriated for building State roads up to 1901-2 the sum of $1,098,910.72; during the same period the counties have appropriated for State work $810,942.55. The towns are required to repair State roads, but if they fail to do so the State repairs them and charges the amount to the towns. In the building of State roads in Connecticut the State pays two-thirds of the cost in towns having a taxable valuation of over $1,000,000 and three-fourths in towns having a taxable valuation of less than $1,000,000.

Delaware.—A law was passed which provides for the appointment of three commissioners to have charge of the State highway work, one in each county; and that the expense of constructing State roads shall be borne equally by the State and county interested. To make this effective an appropriation of $30,000 a year for two years was made.

Florida.—Laws were passed that all moneys now in the internal improvement fund, or which may be derived from the sale of State swamp and overflowed lands,

shall be devoted to the construction of hard roads, being divided among the several counties in proportion to their assessed valuation; that county commissioners may levy a tax, not to exceed three mills, for roads and bridges, half of the amount thus raised in incorporated cities and towns to be expended within their limits, taxpayers to be exempt from road work in counties where such a levy of more than two mills is made, and that upon petition of more than one-fourth of the taxpayers in any road district an election shall be held to determine whether a special road tax, not to exceed five mills per annum, shall be levied, and in case of an affirmative vote three road trustees shall be elected, and biennial meetings of the district shall be held to elect trustees and to determine the amount of the tax.

ILLINOIS.—The appointment of a good roads commission was provided for by a new law. The commission is to consist of three persons, one of whom shall be a highway engineer, and one of whom shall have served as highway commissioner, to investigate the road problems of the State, such as the best and most economical native materials, the best system of road drainage, the most practical methods by which the cost may be distributed among all the people, such as Federal, State, and county aid, convict labor, etc. The commission is to serve without compensation for two years, but $5,000 was appropriated to pay its expenses. It is to report to the next legislature, submitting a bill to amend the present road law. A bill was also passed providing for the use of convicts in the preparation of road materials in the quarries located on the grounds of penal institutions, the material to be donated to the county free of cost.

INDIANA.—The most important road laws enacted provide that 5 per cent of the regular road fund shall be set aside for the purpose of keeping rural mail delivery routes in good condition, and for the direct election of supervisors by road districts, which shall include cities or incorporated towns.

KANSAS.—A bill was passed of which the most important provision authorizes townships to levy a special road tax of not to exceed three mills on the dollar.

MAINE.—Amendments to the State aid law of 1901 provide for increasing the amount payable to towns for permanent improvements to main roads from $100 to $200 per year, and for an annual appropriation of $20,000 for this purpose as against $15,000 hitherto appropriated.

MARYLAND.—An appropriation of $10,000 a year was made for carrying on the work of the commission provided for by the law of 1898.

MASSACHUSETTS.—The legislature appropriated $2,250,000 to be expended for State highways during the next five years. The reduction of $50,000 a year from the average appropriation of the last five years is to a certain extent offset by the definiteness of the appropriation for an extended period. From 1894 to 1903 the legislature has appropriated $6,750,000 for the building of State roads. During this time 480 miles of road have been built by the State, and practically 600 miles by the towns and cities.

MICHIGAN.—A bill was passed providing for the appointment of a State highway commissioner, to whom all local street and highway commissioners, overseers, and superintendents shall make annual report. This commissioner is to gather all possible information about the construction of highways, and furnish the same on request, together with plans and specifications. He may hold schools of instruction and build sample roads, provided no expense to the State is involved. The appropriation is $5,000 a year. The constitutionality of this law has been questioned. Also a law was made permitting townships upon petition of 25 freeholders and by a two-thirds vote to bond themselves for hard roads to an amount not exceeding 5 per cent of the assessed valuation.

MINNESOTA.—Laws were passed as follows: In counties having a population of 150,000 to 200,000 the county commissioners shall provide a highway fund for which they may levy a special tax of not more than one mill, from which they may expend not more than $200 per annum for the construction, improvement, or maintenance of any one town road, and not more than one-fifth of the entire amount for the improvement, construction, or repair of any road in a city or village which intersects with or is a continuation of any country road; authorizing county commissioners to purchase and operate road machines and to lease the same to contractors; providing for a cash road tax (in addition to the poll tax, which may still be worked out) not to exceed five mills and to be expended under the direction of a town overseer of highways. This last provision is mandatory upon the counties of Hennepin and Ramsay and optional with the other counties.

MONTANA.—A new road law has been enacted for the purpose of establishing a uniform system of road administration. The provisions empower the county commissioners to levy a cash bridge tax of not more than one mill to the dollar, compel

them to levy a cash road tax of not less than one mill on the dollar, and a cash road tax of not less than one mill nor more than three mills in addition to a poll tax of $2, which latter may be commuted by one day's highway labor.

NEBRASKA.—Acts were passed providing for cooperation with the Federal Government whenever national road construction shall be undertaken, and reducing the width of country roads nearly one-half.

NEW HAMPSHIRE.—An appropriation of $10,000 was made with provision for the appointment of a State engineer, who shall prepare a highway map of the State and plan a system of continuous main highway which shall include every town in the State. It is also provided in the bill that the governor and council shall prepare a bill for the next general court which will provide fully for the inauguration of a system of State work and State expenditure in the future construction and repair of highways.

NEW JERSEY.—A new State aid law was passed, and will be tested for a year before the old law is repealed. It provides for a maximum annual expenditure by the State of $400,000, but the legislature appropriated only $250,000, as heretofore. The old law provides that on petition of the owners of two-thirds of the land bordering on any public road not less than a mile in length, asking that the road be improved and agreeing to pay 10 per cent of the cost, the county officials shall improve the road, one-third of the expense to be borne by the State and the balance to be paid by the county. Such roads are built under the direction and according to the specifications of the state commissioner of public roads. The State's expenditure for any one year is limited to $400,000, while the counties are limited to one-fourth of 1 per cent of their assessed valuation. From 1893 to 1902 800 miles of road were built, at a total cost to the State of $1,265,168.55.

NEW YORK.—The 1898 law provides that the State shall pay 50 per cent, the counties 35 per cent, and the towns and property owners 15 per cent of the cost of improved roads. Under it 242 miles of road have been built, 242 miles are in process of construction, and petitions are on file in the office of the State engineer for 2,300 miles, for which the counties and towns have already appropriated their half of the cost. The State has already appropriated for this purpose $2,065,000. The last session of the legislature adopted a constitutional amendment that provides that the State may bond itself for $5,000,000 a year for ten years for the purpose of building wagon roads. This amendment must be passed by the next legislature and then submitted to the popular vote before it becomes effective.

NORTH CAROLINA.—An object-lesson road law was passed which provides that the board of county commissioners in any county is empowered to build a public road from their court-house to a distance not exceeding 3 miles. In order to meet the expense of building these roads they have the right to expend any money in the county treasury not otherwise appropriated, and if they have no unappropriated funds they are empowered to build and construct the road by pledging the credit of the county and levying a special tax on the property to pay for the building of a road, provided that the amount shall be charged to the township through which the roads are run, and that the tax shall be levied upon such township, the tax levy not to exceed 10 cents on a hundred dollars and 30 cents on the poll. North Carolina also has a highway commission, established two years ago; the commission is composed of the commissioner of agriculture and the State geologist. Its duties are to collect and disseminate information and report to the legislature.

NORTH DAKOTA.—A bill was passed amending the county road law so as to provide that in counties not organized into civil townships the board of county commissioners may spend not to exceed 5 mills for road purposes, in addition to the tax of 1 mill in counties having a population of 5,000 or more, thus doing away with the old method of having the work done by the supervisors. It also repeals the provision that the road fund can only be expended upon a petition of persons owning taxable property affected.

PENNSYLVANIA.—The new law provides for the appointment of a State highway commissioner, who has to be a practical engineer. His duties are to collect information and compile statistics concerning the character and condition of the highways throughout the State, to investigate and determine upon the character of roads best suited to different sections, to furnish information to the various township, borough, and city road and street officials, to receive petitions, to decide upon the construction of roads under the provisions of the act. The sum of $6,500,000 is appropriated, to be apportioned among the different counties in proportion to the mileage of roads in each county, and to be expended during a period of six years. Two-thirds of the cost of building the roads is paid by the State, one-sixth by the county, and one-sixth by the township through which the highway passes. One-half of the expense of

making repair to State roads is to be paid by the State, and the balance by the county and townships in which the road is located.

RHODE ISLAND.—An appropriation of $100,000 was made for the construction, maintenance, and improvement of highways under the direction of the State board of public roads which was created by the preceding legislature.

SOUTH CAROLINA.—A bill was passed permitting counties to work convicts with ten-year sentences on the chain gang; hitherto the counties had been restricted to convicts with five-year sentences.

TEXAS.—An act was passed permitting counties to bond themselves for improving and maintaining public roads and for purchasing and constructing bridges.

VERMONT.—The law provides for a State highway commission which has supervision, through the town commissioners, of the expenditure of all moneys appropriated by the State for highway improvement, and a State tax for general highway improvement, which is redistributed to the towns on the basis of mileage. The towns are required to use their apportionment of State aid in permanent road work, but before they receive the apportionment from the State they have to first expend a sum at least equal to their apportionment to the satisfaction of the State highway commissioner. The 5 per cent State tax provided for by law, raised during the year 1901, was $88,621, and during the year 1902, $89,507.

WASHINGTON.—A law was passed, the principal provisions of which are that for highway and bridge purposes a poll tax of $2 and an ad valorem tax, to be levied by the county commissioners, of not more than 4 mills for general county work and not more than 10 mills for district work, shall be paid in cash; that counties, exclusive of incorporated cities and towns, shall be divided into not more than four road districts, for each of which a supervisor may be appointed, who may make improvement and repairs costing less than $150; that all construction, improvement, and repair costing more than $150 shall be let by contract, and that all road work shall be under the supervision of the county surveyor.

IRRIGATION IN 1903.

By ELWOOD MEAD, *Chief of Irrigation Investigations.*

WORK OF THE DEPARTMENT OF AGRICULTURE.

The irrigation work of the United States Department of Agriculture is under the direction of the Office of Experiment Stations, and includes investigations of the laws as affecting irrigation and the rights of riparian proprietors, of institutions relating to irrigation, of methods of using water, of the removal of seepage and surplus waters by drainage, of the use of different kinds of power for irrigation, drainage, and other farm operations.

Leading features of the work have been as follows:

Duty of water.—Experiments to determine absolute water requirements of plants, and effects of using different quantities of water, and of applying water at different stages of growth.

Pumping.—Collection of information as to cost, efficiency, and duty of pumps and different means of developing power for their operation.

Irrigation in foreign countries.—A study of the irrigation laws, practices, and works of northern Italy, for suggestions as to improvements in American irrigation.

Irrigation practice.—All the agents of the irrigation investigation were requested to collect information as to the best practices in applying water. From the reports submitted bulletins have been prepared on the use of current wheels for raising water and on preparing land for irrigation.

The Platte River as an interstate stream.—The Platte River as a typical interstate stream was studied for the purpose of determining the effect of diversion in the upper States upon the flow of the stream in the lower State, and existing rights to the river. Report on conditions on the Platte River will aid in the decision of all claims arising on other interstate streams.

Irrigation in semiarid States.—Cost and efficiency of pumps; storage of storm water; effects of winter irrigation.

Irrigation in humid States.—Collection of information regarding methods, cost, and profits of irrigation of vegetables and fruits.

Rice.—Rice irrigation in Louisiana and Texas; determination of the effect of salt water used during previous year; efficiency of the pumps; inspection of rice plantations along the Cooper River near Charleston, S. C., to determine what can be done for their betterment. The great need of this section seems to be the organization of the planters in order that a uniform system of levees and dikes may be constructed.

Drainage.—It has been found that continued irrigation without drainage usually brings about a swamping of the irrigated lands or the rise of alkali in dangerous quantities, so that the Department has been compelled to take up a study of drainage in connection with its irrigation work. This drainage work has been extended to cover the whole United States. During the year 1903 plans and surveys were made for the drainage of lands near Fresno Cal., Sunnyside and North Yakima, Wash., in the Graybull Valley, near Burlington, Wyo., along the Missouri River Valley in western Iowa, and along the Santee and Cooper rivers in South Carolina.

LEGISLATION.

California.—The law was changed to allow extension of time for beginning works through public reservations and to allow changes of place of diversion of water, of use, and of means of diversion after notice has been filed; also to provide for dissolution of irrigation districts and for taking over of district property by companies formed under the general incorporation laws.

Colorado.—Under the law maps and statements for proposed diversion of water must be filed with the State engineer and filed with county clerk. The procedure for defining water rights for irrigation is extended to include rights for other purposes, and water commissioners have control of all diversion of water from streams. Under amendments of the law the point of diversion of water may be changed from one district to another; division engineers clearly under control of the State engineer replace division superintendents; districts are empowered to buy works and lands; petitioners for the organization of an irrigation district must have paid property taxes in the district in the preceding year; expenditures of $10,000 to $25,000 must be approved by a majority of the legal electors; districts are empowered to lease water to parties outside district, to go outside of the State to secure water, and to make a second issue of bonds, when necessary, constituting a subordinate lien, with first interest payable from sale of bonds; county surveyors are required to survey reservoir sites for owners of at least 10 acres, to supervise construction, and annually inspect reservoirs.

Idaho.—A complete code of water laws was adopted, providing for the adjudication of existing water rights, the acquisition of rights, and the distribution of water by State officials. The State is divided into three divisions, and divisions into districts. Water masters manage distribution according to court decrees and State licenses. Water-right owners must maintain measuring flumes for water masters.

To acquire a water right application is made to the State engineer, who is to approve it when in proper form, and, after completion of works, to inspect, and issue license confirming use of water under the law; but no license can grant the use of more water than can be beneficially applied to the lands for which it is given.

In suits regarding water rights the State engineer is to make and state measurements for the court. A provision for suits by water commissioners has been adjudged unconstitutional.

Amendments to the irrigation district law authorize loans from the United States under the reclamation law and district tax levies, including State lands, for repayment of loans or bonds.

Montana.—The Carey land act board, replacing the arid land grant commission, consists of the newly created State engineer, State examiner, and secretary of state. The State engineer is to measure the discharge of streams and collect information as to flow.

Nebraska.—Proceedings to divert water were extended to include storage. Taking water contrary to an "under assistant's" order was made misdemeanor. Owners of irrigation ditches must provide headgate and measuring box, under approved plan, at the head of each lateral. Persons holding leases with five years to run are allowed to help organize irrigation districts. Districts are empowered to tax State land leaseholds and to buy certain bonds with surplus funds. When districts are dissolved provision for payment of their debts must be made.

Nevada.—A new code of water laws was adopted requiring the State irrigation board to divide the State into divisions, appoint water commissioners to give appropriators of water their just shares, and creating a State engineer who is to collect claims, make measurements, and define rights to water with right of appeal to the courts. The commissioners are under the State engineer.

Utah.—A new water code was adopted. The State engineer divides the State into divisions and districts and appoints division superintendents, who appoint district supervisors to distribute water. The engineer also is to measure streams and diversion ditches, and may initiate actions for defining water rights to streams so measured. The court, upon notice from the engineer, calls for the filing of claims which are tabu-

lated by the engineer, and upon a hearing the court defines the rights of all claimants. Also any question involving water rights may be arbitrated.

Water rights are acquired by application to the State engineer, who is to refuse when no water is available or detriment to public interests is probable. When irrigation works are completed a permit is issued, stating flow and time of use.

Oregon.—A law was passed for a commission to be appointed to propose changes in the water laws.

Washington.—County commissioners are to appoint water commissioners upon application of twelve owners of irrigated land.

Wyoming.—Proceedings to appropriate water were extended so as to include storage, with privilege of sale for use anywhere.

COURT DECISIONS.

Under a contract by which the works were to become the property of the contract holders when rights sold should equal the capacity of the works, the Colorado supreme court awarded the works to a company of the contract holders who purchased before the capacity was exceeded.

The Nebraska supreme court defined the relation of riparian rights and rights of diversion as follows:

The two doctrines stand side by side. They do not necessarily overthrow each other, but one supplements the other. The riparian owner acquires title to his usufructuary interest in the water when he appropriates the land to which it is an incident, and where the right is once vested it can not be divested except by some established rule of law. The appropriator acquires title by appropriation and application to some beneficial use, and of which he can not be deprived except in some of the modes prescribed by law. The time when either right accrues must determine the superiority of title as between conflicting claimants. The law of 1889 abrogating the doctrine of riparian rights did not abolish riparian rights which had already accrued, but only prevented the acquisition of such rights in the future.

The Wyoming supreme court held that rights by prior appropriation should be recognized regardless of State lines; and held:

The district court of Wyoming has jurisdiction to adjudicate the rights of the owners of land in Montana to the water of the stream so far as may be necessary to protect their rights, though the court may not have jurisdiction to enter a decree for quieting the title of such owners to the water claimed.

WORK OF THE DEPARTMENT OF THE INTERIOR.

Construction of irrigation works by the United States Government was provided for by the law approved June 17, 1902. This work is placed under the direction of the Secretary of the Interior, and is carried on under the supervision of the Director of the United States Geological Survey. The law sets aside the proceeds of the sales of public lands as a reclamation fund. The following table showing the approximate amount in this fund, and the amounts arising in the several States, is taken from the report of the Commissioner of the General Land Office for 1903:

Statement of reclamation fund.

States and Territories.	1901.	1902.	1903, approximately.	Aggregate, approximately.
Arizona	$42,586.16	$39,187.35	$43,831.82	$125,605.33
California	205,030.40	298,240.36	783,849.10	1,287,119.86
Colorado	254,889.88	374,105.13	510,072.44	1,139,067.45
Idaho	206,645.36	300,803.27	642,218.52	1,149,667.15
Kansas	20,188.78	28,946.94	18,417.44	67,553.16
Montana	367,342.31	405,035.49	552,168.41	1,324,546.21
Nebraska	102,963.24	132,234.94	118,838.64	354,036.82
Nevada	9,183.47	14,230.61	12,465.23	35,879.31
New Mexico	75,203.06	72,034.60	150,127.70	297,365.36
North Dakota	449,474.96	778,021.35	1,228,843.89	2,456,340.20
Oklahoma	370,464.93	638,330.44	816,086.57	1,824,881.94
Oregon	364,988.62	545,972.44	1,884,729.83	2,795,690.89
South Dakota	113,274.20	194,288.17	239,420.59	546,982.96
Utah	98,416.00	48,408.38	87,519.66	234,344.04
Washington	257,180.95	536,907.82	1,099,980.42	1,894,069.19
Wyoming	206,989.59	178,773.24	272,923.64	658,686.47
Total	3,144,821.91	4,585,520.53	8,461,493.90	16,191,836.34

A large number of withdrawals have been made in the various States and Territories, and surveys are being made to determine the feasibility of the projects proposed in connection with them. Two projects have been approved and contracts for a part of the work on each have been let. These are a reservoir at the mouth of Tonto Creek in the Salt River basin, and the Truckee Canal in Nevada. The former will supply water to the canals now taking water from the Salt River, and will furnish water to 200,000 acres of land. The Truckee Canal is to take water from the Truckee River to a reservoir site on the lower Carson River, from which the water can be taken to the lands to be reclaimed. The areas to be reclaimed have not yet been decided upon.

DISPOSAL OF LAND BY THE GENERAL GOVERNMENT FOR IRRIGATION.

The United States Government disposes of land for irrigation under two laws, the desert-land law, and the "Carey law" (act of August 18, 1894). Land disposed of under other laws may or may not be for irrigation. During the fiscal year ended June 30, 1903, there were original entries of 1,025,825.77 acres under the desert-land law, and final entries of 264,533.62 acres. Under the Carey law land was applied for and segregated, as follows:

Land applied for and segregated under Carey law during the year ended June 30, 1903.

States.	Applied for.		Segregated.	
	Number of lists.	Area.	Number of lists.	Area.
		Acres.		*Acres.*
Colorado	1	37,865.79		
Idaho			2	11,892.46
Nevada	4	2,082.39		
Oregon	3	89,228.57	1	84,707.74
Washington	2	14,608.14		
Wyoming	3	210,740.56	1	14,424.94
Total	13	354,525.45	4	111,025.14

IRRIGATION CONSTRUCTION.

There are no records of irrigation construction. The activity in that line is shown to some extent by the records of filings of claims or application in the States where such filings are required. The filing of a claim or application for permit is not necessarily followed by construction, but the number of filings is some index to the activity in such work.

Colorado.—Claims for the diversion of 33,073.15 cubic feet per second and for the storage of 2,388,659 acre-feet were filed.

Idaho.—Under the new law requiring the securing of permits to appropriate water 406 applications were approved in 1903. The plans filed call for the expenditure of $3,500,000, and propose the irrigation of 1,017,000 acres of land. Under the irrigation district law four districts are in operation and two are being formed. The six propose the irrigation of 188,000 acres at an expense of $1,208,000. Under the "Carey act" (28 U. S. Stat., 372–422) six enterprises are under construction, providing for the irrigation of 420,500 acres at an expense of $2,750,000.

Nebraska.—Forty-one applications were received, contemplating the construction of about 100 miles of canals, covering 40,000 acres of land.

Wyoming.—During 1903 there were issued 502 permits for new canals, and 179 permits for the enlargement of existing works. Eighty-five applications for permits to construct reservoirs were received and recorded.

EXTENT OF IRRIGATION IN THE UNITED STATES.

The following table, showing the extent of irrigation in the United States and the increase from 1899 to 1902, is furnished by the Census Bureau of the Department of Commerce and Labor. The figures in some cases are subject to a final revision, which may be made from the publications of that Bureau. It is not believed that any very considerable change will be made by such revision.

Irrigation statistics for the United States.

[Furnished by U. S. Census Bureau.]

	1899.		1902.		Gain.	
	Acres irrigated.	Cost of systems.	Acres irrigated.	Cost of systems.	Acres irrigated.	Cost of systems.
United States	7,782,059	$71,514,754	9,478,852	$92,649,405	1,694,981	$21,776,985
Arid States	7,263,273	64,289,601	8,469,198	77,368,623	1,198,502	13,168,749
Arizona	185,396	4,438,352	247,250	4,688,298	61,854	249,946
California	1,445,872	19,181,610	1,708,720	23,772,157	262,848	4,590,547
Colorado	1,611,271	11,758,703	1,754,755	14,758,997	136,061	3,093,021
Idaho	602,568	5,120,399	713,595	6,190,071	111,027	1,069,672
Montana	951,154	4,683,073	1,140,694	5,576,975	189,540	893,902
Nevada	504,168	1,537,559	570,001	1,706,212	65,883	168,653
New Mexico	203,893	4,165,312	254,945	4,301,915	51,052	136,603
Oregon	388,310	1,843,757	439,981	2,089,609	65,883	168,653
Utah	629,293	5,865,302	711,184	7,252,582	81,891	1,387,280
Washington	135,470	1,722,369	154,962	2,330,758	19,492	608,389
Wyoming	605,878	3,973,165	773,111	4,701,049	167,233	727,884
Semiarid States	273,117	3,192,660	571,851	8,802,424	299,634	5,616,064
Kansas	23,620	529,755	28,922	599,098	5,302	69,343
Nebraska	148,538	1,310,698	245,910	2,463,748	98,272	1,159,350
North Dakota	4,872	17,980	10,384	45,087	5,512	27,107
Oklahoma	2,759	21,872	3,328	36,770	569	14,898
South Dakota	43,676	284,747	53,137	381,569	9,461	96,822
Texas[a]	49,652	1,027,608	230,170	5,276,152	180,518	4,248,544
Rice States	242,514	3,743,812	437,803	6,478,358	195,289	2,734,546
Georgia	7,856	250,213	8,581	274,990	725	24,777
Louisiana	201,685	2,529,319	387,580	4,747,359	185,895	2,218,040
North Carolina	3,283	112,771	3,422	112,905	134	134
South Carolina	29,690	851,509	38,220	1,343,104	8,530	491,595

[a] This includes rice irrigation.

PUBLICATIONS OF THE DEPARTMENT OF AGRICULTURE.

The publications of the United States Department of Agriculture are mainly of three general classes:

I. Publications issued annually, comprising the Yearbooks, the Annual Reports of the Department, the annual reports of the Bureau of Animal Industry, Weather Bureau, and Bureau of Soils.

II. Other departmental reports, divisional bulletins, etc. Of these, each bureau, division, and office has its separate series, in which the publications are numbered consecutively as issued. They comprise reports and discussions of a scientific or technical character.

III. Farmers' Bulletins, divisional circulars, reprinted Yearbook articles, and other popular papers.

The publications in Class I are distributed by the Department and by Senators and Representatives in Congress. For instance, of the 500,000 copies of the Yearbook usually issued the Department is allotted only 30,000, while the remaining 470,000 copies are distributed by members of Congress. The Department's supply of the publications of this class is therefore limited, and consequently has to be reserved almost exclusively for distribution to its own special correspondents and in return for services rendered.

The publications of Class II are not for distribution by members of Congress, and they are not issued in editions large enough to warrant free general distribution by the Department. The supply is used mainly for distribution to those who cooperate with the Department or render it some service, and to educational and other public institutions. A sample copy of this class of publications can usually be sent on application, but aside from this the Department generally finds it necessary to refer applicants to the Superintendent of Documents, of whom further mention is made below.

The publications of Class III treat in a practical way of subjects of particular interest to farmers. They are usually issued in large editions, and are for free general distribution by the Department. The Farmers' Bulletins are also for distribution by Senators and Representatives in Congress, to each of whom is furnished annually, according to law, a quota of several thousand copies for distribution among his constituents.

A limited supply of nearly all the publications in Classes I and II is, in compliance with the law, placed in the hands of the Superintendent of Documents for sale at cost of printing. Applications for these should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C., and should be accompanied by postal money order payable to him for the amount of the price. No postage stamps nor private checks should be sent. The Superintendent of Documents is not permitted to sell more than one copy of any public document to the same person. The Public Printer may sell to one person any number not to exceed 250 copies if ordered before the publication goes to press. Under a recent resolution the Superintendent of Documents is permitted, with the approval of the head of any Department of the Government, to reprint any public document in numbers sufficient to supply the demand under the restriction of not more than one copy to the same person.

The Secretary of Agriculture has no voice in designating the public libraries which shall be depositories of public documents. Of the distribution of documents to such depositories, including the publications of this and all other Departments of the Government, the Superintendent of Documents has full charge.

For publications of the Weather Bureau requests and remittances should be directed to the Chief of the Weather Bureau.

The Department has no list of persons to whom all publications are sent. A monthly list is issued on the first day of each month giving the titles of all publications issued during the previous month, with all the explanations necessary to enable applicants to order intelligently. This list will be mailed regularly to all who apply for it. The Department also issues and sends out to all who apply for them a complete list of all publications of which the Department has a supply for free distribution, and a similar list of all the Department's publications for sale by the Superintendent of Documents.

PUBLIC LANDS OPEN FOR SETTLEMENT.

The figures given in the table below show the location of the public lands in the United States still open for occupation under the homestead and other laws for acquisition of title by individuals. In general, the lands noted in the column "Area surveyed" are available for immediate private occupation under any of the laws now in force for grant of title by the Government. The lands scheduled as "Unsurveyed" must, of course, be surveyed before a grant can be made. The column head "Area appropriated" indicates roughly to what extent the section where the lands are located is already settled and under cultivation.

Applications for and information regarding public lands should be addressed to the registers and receivers of the United States district land offices in the places noted in the table. Full information should be obtained before any move is made toward occupation of these lands.

The total amount of land disposed of by the Government in the fiscal year ended June 30, 1903, was 22,824,299.65 acres, and the gross receipts in payment for it, $11,024,743.65, of which approximately $8,461,493.90 was turned over to the fund for the reclamation of arid lands.

Lands open for settlement, and location of land offices in the United States, June 30, 1903.

[Abridged from Report of Commissioner of General Land Office.]

State and location of office.	Area unappropriated.		Area appropriated.
	Area surveyed.	Area unsurveyed.	
ALABAMA.	*Acres.*	*Acres.*	*Acres.*
Huntsville	101,520	....	7,790,080
Montgomery	156,900	....	24,557,460
ARIZONA.			
Prescott	5,816,047	18,848,794	3,364,003
Tucson	5,874,991	16,463,989	2,264,659
ARKANSAS.			
Camden	616,809	....	7,896,131
Dardanelle	945,006	....	3,224,494
Harrison	763,710	....	4,477,290
Little Rock	434,028	....	15,183,652

Lands open for settlement, and location of land offices in the United States, June 30, 1903—Continued.

State and location of office.	Area unappropriated.		Area appropriated.
	Area surveyed.	Area unsurveyed.	
CALIFORNIA.	*Acres.*	*Acres.*	*Acres.*
Eureka	830,131	188,934	2,227,252
Independence	8,775,041	3,607,331	729,965
Los Angeles	9,266,295	2,602,271	6,012,715
Marysville	700,552	170,955	4,109,390
Redding	2,382,250	266,158	4,592,040
Sacramento	581,379	82,482	2,324,039
San Francisco	3,264,132	181,129	10,749,506
Stockton	327,686	36,033	4,748,040
Susanville	2,730,732	254,412	1,905,220
Visalia	598,478	119,149	5,888,196
COLORADO.			
Akron	796,864		2,220,636
Del Norte	2,216,642	605,860	1,288,518
Denver	4,620,958	329,660	5,778,362
Durango	2,944,728	468,611	693,361
Glenwood Springs	6,156,543	1,266,296	1,326,139
Gunnison	1,741,735	532,393	434,792
Hugo	1,650,667		751,494
Lamar	3,155,274		1,916,726
Leadville	1,401,227	302,723	692,910
Montrose	3,047,760	776,303	664,897
Pueblo	4,938,529	6,240	5,172,169
Sterling	967,603		1,994,897
FLORIDA.			
Gainesville	1,179,197	160,070	33,714,114
IDAHO.			
Blackfoot	3,658,729	2,679,840	4,082,931
Boise	4,010,156	7,357,043	1,566,662
Cœur d'Alene	623,000	2,433,770	1,362,001
Hailey	3,326,161	12,531,214	1,224,762
Lewiston	758,239	4,407,628	1,937,273
KANSAS.			
Colby	100,760		6,550,020
Dodge City	664,938		15,492,162
Wakeeney	282,133		6,046,587
LOUISIANA.			
Natchitoches	70,961	65,018	3,880,175
New Orleans	39,003		23,531,769
MICHIGAN.			
Marquette	365,065		36,334,440
MINNESOTA.			
Crookston	668,165	1,034,520	7,418,235
Duluth	2,794,382	636,038	6,264,505
St. Cloud	35,580		12,516,300
MISSISSIPPI.			
Jackson	112,720		29,572,400
MISSOURI.			
Boonville	57,820		26,243,180
Ironton	79,180		9,917,820
Springfield	90,158		7,407,682
MONTANA.			
Bozeman	1,947,050	1,801,810	3,469,860
Greatfalls	7,163,903	7,475,527	3,384,916
Helena	2,339,453	5,416,396	3,383,202
Kalispell	192,836	3,576,907	2,000,757
Lewiston	3,024,927	2,803,396	2,207,399
Miles City	3,142,676	14,444,786	2,369,698
Missoula	433,481	4,122,515	1,507,971
NEBRASKA.			
Alliance	2,455,407		3,401,791
Brokenbow	2,056,169		1,978,551
Lincoln	2,600		11,856,680

Lands open for settlement, and location of land offices in the United States, June 30, 1903—Continued.

State and location of office.	Area unappropriated.		Area appropriated.
	Area surveyed.	Area unsurveyed.	
	Acres.	*Acres.*	*Acres.*
NEBRASKA—continued.			
McCook	176,080		5,696,920
North Platte	694,438		3,730,883
O'Neill	691,580		7,940,420
Sidney	503,638		2,762,522
Valentine	2,265,994		2,313,996
NEVADA.			
Carson City	30,792,220	30,485,688	3,075,323
NEW MEXICO.			
Clayton	7,135,920	419,404	1,291,676
Lascruces	13,599,247	5,472,513	1,437,720
Roswell	8,201,064	5,861,313	2,099,173
Santa Fe	10,400,417	2,682,481	13,221,113
NORTH DAKOTA.			
Bismarck	5,050,365	3,629,536	8,335,599
Devils Lake	171,920		5,161,800
Fargo	72,000		7,885,070
Grand Forks	8,320		4,166,960
Minot	3,447,259	817,939	2,837,822
OKLAHOMA.			
Alva	43,916		1,670,821
Elreno	6,818		2,697,395
Guthrie	90		2,377,845
Kingfisher	126,659		3,593,924
Lawton	16,681		1,510,279
Mangum	43,475		2,050,840
Woodward	2,853,694		2,919,626
OREGON.			
Burns	4,029,076	1,386,719	1,815,757
Lagrande	2,123,299	202,422	4,113,267
Lakeview	6,380,032	3,242,240	2,617,308
Oregon City	455,018	141,690	5,679,846
Roseburg	1,069,523	621,170	6,973,846
The Dalles	3,125,771	328,826	4,169,800
SOUTH DAKOTA.			
Aberdeen	92,920		3,221,328
Chamberlain	1,286,384	75,770	1,540,096
Huron	33,331		4,341,954
Mitchell	1,080		7,167,920
Pierre	1,398,354		1,547,889
Rapid City	7,710,185	306,831	2,587,984
Watertown	299		5,171,701
UTAH.			
Salt Lake City	11,526,008	29,843,553	4,981,234
WASHINGTON.			
North Yakima	528,743	758,891	2,467,453
Olympia	70,951	122,143	2,766,714
Seattle	127,917	239,039	3,269,970
Spokane	627,043	1,824,996	4,921,320
Vancouver	266,453	169,372	3,471,040
Walla Walla	558,432	274,859	2,331,418
Waterville	2,284,646	1,631,707	2,168,568
WISCONSIN.			
Ashland	55,860		2,990,807
Eau Claire	23,578		14,194,171
Wausau	33,563		17,541,417
WYOMING.			
Buffalo	6,293,333	768,897	1,259,309
Cheyenne	8,597,508	65,261	3,051,041
Douglas	7,471,196	226,998	809,806
Evanston	5,735,510	1,377,625	2,574,868
Lander	1,720,433	136,090	765,888
Sundance	4,726,018		1,062,659

FARMERS' INSTITUTES.

Farmers' institutes were held during the year ended June 30, 1903, in all of the States and Territories excepting Arkansas, South Dakota, Wyoming, Alaska, Indian Territory, and Porto Rico. The following table gives a summary of the work so far as reports could be secured. The results show an increase in the number of institutes held over the previous year of 284.

The method adopted by the State directors in computing the total attendance for the year has heretofore not been uniform. This will be corrected in the future through the action of the American Association of Farmers' Institute Workers taken at its recent meeting in Toronto, suggesting a method of estimating the attendance, which all State directors are requested to observe. The resolution proposes that in making up the aggregate attendance the number present at the best attended session of an institute be taken, and to it be added the one-half of the number present at the next best attended session. This sum is to be regarded as the total attendance for that institute. The sum of the totals of all of the institutes held in the State, computed in this way, is to be reported as the attendance in that State for that year.

This new method has been adopted by some of the States reporting attendance in the accompanying table. The effect has been to show an apparent falling off in attendance in some of the States over last year, but the total for the country shows an increase of 59,739.

Statistics of farmers' institutes for season ended June 30, 1903.

States and Territories.	Meetings.					Speakers on State force.	Funds for institutes.		Reports of proceedings.		Methods of distribution.
	Total number.	One day.	Two days or more.	Number of sessions.	Total attendance.		Appropriated year ended June 30, 1903.	Appropriated year ended June 30, 1904.	Published.	Number of copies.	
Alabama	22	22	....	50	2,618	11	$600	$800	No..	....	
Arizona	2	....	....	20	1,000	4	60	2,700	No..	....	
California	60	12	45	254	20,000	23	4,000	6,000	Yes.	10,000	Through agricultural journals and State report.
Colorado	10	6	4	20	1,300	9	385	....	No..	....	
Connecticut	9	8	1	25	4,000	21	700	700	Yes.	5,000	
Delaware	28	21	7	67	4,800	19	800	600	No..	....	
Florida	21	20	1	42	2,900	22	2,500	2,500	Yes.	5,000	
Georgia	15	14	1	32	3,500	8	1,000	1,000	No..	....	
Hawaii	4	4	....	4	160	....	35	150	No..	....	
Idaho	17	5	12	75	2,550	9	1,000	1,000	Yes.	6,000	By mail.
Illinois	108	....	108	......	42,876	84	18,150	19,650	Yes.	....	
Indiana	181	3	178	858	73,653	39	10,000	10,000	Yes.	600	Annual Report State Board of Agriculture.
Iowa	64	....	64	348	17,750	....	7,425	7,425	No..	....	
Kansas	92	82	10	204	38,085	16	2,000	2,000	No..	....	
Kentucky	8	2	6	......	2,000	11	....	....	......	10,000	Supplements to agricultural journals.
Louisiana	50	48	2	134	13,245	13	2,000	2,000	......	3,500	Through mailing lists and institutes.
Maine	40	40	....	83	5,846	9	3,000	3,000	Yes.	6,000	State reports.
Maryland	40	22	18	116	11,222	7	4,000	4,000	No..	....	
Massachusetts	120	120	....	154	12,487	68	2,000	2,700	No..	....	
Michigan	284	213	71	885	53,037	97	7,500	7,500	Yes.	8,000	Through the institutes.
Minnesota	100	85	15	238	35,171	13	16,500	18,000	Yes.	30,000	Institute Annual.
Mississippi	58	56	2	122	10,000	15	1,500	1,500	Yes.	18,000	By experiment stations.
Missouri	127	50	77	......	25,400	31	4,000	5,000	No..	....	
Montana	16	16	....	32	600	16	2,000	4,000	Yes.	5,000	At institutes and through mails.
Nebraska	65	23	42	268	25,000	33	4,000	6,000	No..	....	
Nevada	3	....	3	18	983	5	120	1,000	No..	....	
New Hampshire	18	18	....	36	6,300	14	1,000	....	Yes.	2,000	
New Jersey	31	12	19	119	6,850	38	2,000	2,000	No..	....	
New Mexico	3	1	2	13	375	5	125	....	No..	....	
New York	312	106	206	1,363	138,528	66	20,000	20,000	Yes.	25,000	By State director and legislature.
North Carolina	15	15	....	25	1,525	8	600	1,000	No..	....	

Statistics of farmers' institutes for season ended June 30, 1903—Continued.

States and Territories.	Meetings.					Speakers on State force.	Funds for institutes.		Reports of proceedings.		Methods of distribution.
	Total number.	One day.	Two days or more.	Number of sessions.	Total attendance.		Appropriated year ended June 30, 1903.	Appropriated year ended June 30, 1904.	Published.	Number of copies.	
North Dakota	19	3	16	67	2,655	11	$1,500	$4,000	Yes.	10,000	At institutes and through mails.
Ohio	263	....	263	1,250	81,752	29	16,981	16,750	Yes.	10,000	By agricultural societies and institute officers.
Oklahoma	29	23	6	36	....	6	1,000	....	......	....	
Oregon	20	10	10	60	4,000	6	300	1,000	No..	....	
Pennsylvania	327	49	278	831	112,550	58	15,000	17,500	Yes.	31,600	By legislatures and department of agriculture.
Rhode Island	1	1	....	1	20	1	44	....	Yes.	....	
South Carolina	50	50	....	50	{ 5,700 { 8,690	}12	{ 150 { 1,000	} 1,000	No..	....	
Tennessee	40	....	....	......	10,000	7	2,500	5,000	......	....	
Texas	64	....	....	180	5,376	....	2,100	3,000	No..	....	
Utah	40	40	....	40	3,200	10	1,500	1,500	Yes.	5,000	By mail.
Vermont	41	41	....	108	16,400	26	5,000	5,000	Yes.	3,000	Do.
Virginia	72	72	....	144	18,000	3	....	3,500	......	....	
Washington	12	3	9	......	1,800	3	2,500	2,500	......	....	
West Virginia	158	23	135	632	15,750	16	5,451	6,000	Yes.	....	Newspapers.
Wisconsin	120	20	100	566	55,000	22	12,000	12,000	Yes.	60,000	

STATE STANDARDS FOR DAIRY PRODUCTS, 1903.

States.	Milk.			Skim milk.	Cream.	Butter.	Cheese.
	Total solids.	Solids not fat.	Fat.	Total solids.	Fat.	Fat.	Fat.
	Per cent.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	
California	....	....	....	....	....	....	Full cream, 30 p. c. fat; half skim, 15 p. c. fat; skim from skim milk. Fancy excepted.
Colorado	....	....	....	....	....	....	Full cream, 35 p. c. total solids to be fat; skim, fat less than 35 p. c. of total solids.
Dist. of Columbia	....	9	3.5	9.3	20	83 Not over 12 p. c. water or 5 p. c. salt.	
Georgia	....	8.5	3.5	....	....	....	
Idaho	....	8	3	....	....	....	Full cream, 30 p. c. fat (fancy excepted); skim, less than 30 p. c. fat; filled, less than 15 p. c.; adulterated, sale prohibited.
Illinois [a]	....	....	3	....	[b]15	80	Whole milk, 48 p. c. total solids to be fat.
Indiana	....	9	3	....	....	80 Maximum water, 15 p. c.; salt, 6 p. c.	Skim, minimum fat 10 p. c.
Iowa	12.5	....	3	....	15	....	
Kentucky	12	....	3	....	15	80	Skim, less than 10 p. c. fat.
Maine	12	....	3	....	....	....	
Maryland [c]	12.5	....	3.5	....	....	....	

[a] Condensed milk must contain not less than 8.5 per cent fat; evaporated cream containing less than 15 per cent fat must be labeled "an unsweetened condensed milk."

[b] Coffee cream shall contain at least 15 per cent fat, and whipping cream at least 22 per cent fat.

[c] Condensed milk must contain the equivalent of 12.5 per cent of milk solids in crude milk of which 3.5 per cent shall be fats.

State standards for dairy products, 1903—Continued.

States.	Milk.			Skim milk.	Cream.	Butter.	Cheese.
	Total solids.	Solids not fat.	Fat.	Total solids.	Fat.	Fat.	Fat.
	Per cent.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	
Massachusetts	13	9.3	3.7	9.3			
April-September	12	9	3				
Michigan	12.5		3				
Minnesota	Sp. grav. 1.029-33 13		3.5	Sp. grav. 1.032-37	20	Maximum water, 16 p. c.	Full cream, 45 p. c. total solids to be fat; skim, fat less than 45 p. c. of total solids.
Missouri							Full cream, from milk with 3 p. c. fat; skim from milk less than 3 p. c. fat.
Montana	12	9	3	9 p. c. solids, not fat.	15		
Nebraska			3		15		
New Hampshire	13	9.5	3.5	9			
April and Sept	12		3				
New Jersey	12						
New York [a]	12		3				Skim, from skim milk.
North Carolina [b]	12	8.5	3.25		18	82.5	Full cream, 50 p. c. total solid to be fat; skim, from skim milk; cream cheese, milk 6 p. c. minimum fat.
North Dakota	12		3		15		Skim, from skim milk.
Ohio [a]	12		3			80	Full cream, 20 p. c. fat; skim, less than 20 p. c. fat.
May and June	11.5						
Oregon	12	9	3	9 Sp. grav. 1.038	20	Not over 14 p. c. water.	Full cream, 30 p. c. fat; half skim, 15 to 30 p. c.; quarter skim, 7½ to 15 p. c.; skim, less than 7½ p. c. Fancy excepted.
Pennsylvania	12		3	8			Full cream, 32 p. c. fat; three-fourths cream, 24 p. c. fat; one-half cream, 16 p. c. fat; one-fourth cream, 8 p. c. fat; skim, below 8 p. c. fat. Fancy, less than 5 pounds, excepted.
Porto Rico	12		3			80 Maximum water, 16 p. c.; salt, 6 p. c.	Fat, 15 to 68 p. c.; water, 20 to 64 p. c.; ash, 1 to 9 p. c.
Rhode Island	12		2.5				
South Carolina		8.5	3				
South Dakota	13		3		20	80	Full cream, 45 p. c. solids to be fat; skim, fat less than 45 p. c.
Utah	12.5		3	9 p. c. solids not fat.	20	83	Skim, 7 to 11 inches in diameter; minimum height, 9 inches.
Vermont	12.5	9.25					
May and June	12						
Washington		8	3		18		Full cream, 30 p. c. fat; skim, 15 p. c. fat. Fancy excepted.
Wisconsin			3				Skim, 10 inches in diameter, 9 inches height.
Wyoming [a]	12		2.4			80	Skim, less than 20 p. c. fat.
May and June	11.5						

[a] In New York, Ohio, and Wyoming the milk solids of condensed milk must be in quantity the equivalent of 12 per cent of milk solids in crude milk of which solids 2.5 per cent shall be fat.
[b] Condensed milk must contain 28 per cent milk solids and 7 per cent fat.

ARBOR DAY IN VARIOUS STATES AND TERRITORIES.

The following table, prepared in the Bureau of Forestry, shows the growth of sentiment in favor of a State Arbor Day:

Arbor Day in the several States and Territories.

States and Territories.	When first observed.	Annual observance.
Alabama	1887	February 22.
Alaska		Not observed.
Arizona	Feb. —, 1895	Friday following 1st day of April, also Friday following 1st day of February.
Arkansas	Dec. 15, 1895	December 15 (irregularly observed).
California		Observed by separate counties, but not generally.
Colorado	1890	Third Friday in April.
Connecticut	1886	Appointed by governor, last Friday in April or first in May.
Delaware	1901	Appointed by governor, usually in April.
District of Columbia		Not observed.
Florida	Feb. 9, 1886	First Friday in February.
Georgia	1890	First Friday in December.
Idaho	1886	Last Monday in April.
Illinois	1888	Date fixed by governor and superintendent of public instruction.
Indian Territory		Not observed.
Indiana[a]	1884	Last Friday in October.
Iowa	1887	Date fixed by proclamation of governor.
Kansas	1875	Do.
Kentucky	1894	Not regularly observed.
Louisiana		Not observed.
Maine	1887	Date fixed by proclamation of governor, usually early in May.
Maryland	Apr. 10, 1889	In April. Date fixed by proclamation of governor.
Massachusetts	1886	Last Saturday in April.
Michigan	Apr. —, 1885	Last Friday in April.
Minnesota	1895	Date fixed by proclamation of governor, usualiy last of April or first of May.
Mississippi	Dec. 10, 1902	December 10.
Missouri	Apr. 16, 1886	Friday after first Tuesday in April.
Montana	Mar. 11, 1895	Second Tuesday in May.
Nebraska	Apr. 10, 1872	April 22.
Nevada	1887	Date fixed by proclamation of governor, usually in April.
New Hampshire	1885	No date fixed, usually in May.
New Jersey	Apr. 18, 1884	Usually third Friday in April, appointed by governor.
New Mexico	Feb. 16, 1891	Second Friday in March.
New York	May 3, 1889	Friday following 1st day of May.
North Carolina		October 12, usually observed.
North Dakota	May —, 1890	First Friday in May.
Ohio	Apr. 27, 1882	Second or third Friday in April.
Oklahoma		Second Friday in April.
Oregon	Apr. —, 1887	Appointment by governor in April or May.
Pennsylvania	1887	In October. Appointment by superintendent of instruction.
Rhode Island	Apr. 29, 1886	Second Friday in May.
South Carolina	Nov. —, 1899	Third Friday in November.
South Dakota		Date fixed by governor.
Tennessee	1887	Date fixed annually in November.
Texas	Feb. 22, 1889	February 22.
Utah	1896	April 15.
Vermont	1885	Latter part of April or first of May.
Virginia	1892	
Washington		Irregularly observed; date set by governor; different dates east and west of The Cascades.
West Virginia	1881	Third Friday in April and third Friday in November.
Wisconsin	1889	Date fixed by governor.
Wyoming	1888	Do.

[a] Not annually observed until 1896.

STATUTORY WEIGHTS OF THE BUSHEL.

States and Territories.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Shelled corn.	Corn on cob.	Corn meal unbolted, and rye meal.	Bran.	Malt.	Potatoes, Irish.	Potatoes, sweet.	Carrots.	Onions.	Turnips, English.	Beets.	Beans.	Peas.	Apples.	Dried apples.	Dried peaches.	Castor beans.	Flaxseed.	Hemp seed.	Millet seed.	Timothy seed.	Blue-grass seed.	Hungarian grass seed.	Clover seed.	Legislative enactments.
United States	60	56	32	48	48	56		a48		34	60						60	60				50	56							Act July 18, 1866. Tariff act, 1897.
Alabama	60	56	32	47		56	70	a48			60	55			55		60	60		24	b33									Act Feb. 18, 1891.
Alaska																														
Arizona	60	56	32	45		54											60													Comp. Laws, 1864–71.
Arkansas	60	56	32	48	52	56	70	a48	20		60	50		57	57		60	60	50	24	33		56		50	60	14		60	Act Mar. 30, 1887.
California	60	54	32	50	40	52																								Code and Stat., 1886.
Colorado	60	56	32	48	52	56	70	a50			60			57			60							44		45	14		60	Gen. Stat., 1891.
Connecticut	60	56	32	48	48	56		a50	20		60	54	50	52	50	60	60	60	48	25	33		55			45			60	Gen. Stat., 1902.
Delaware	60					56		a48																						Acts 1853, 1867, 1896.
District of Columbia	60	56	32			56		48			60																			Webb's Laws, 1868. U. S. Stat., 1896.
Florida	60	56	32	48		56	70	a48	20		60	60		56	54		c60		48	24	33	48			50					Stat., 1901.
Georgia	60	56	32	47	52	56	70	a48	20		60	55		57	55		60	60		24	33		56	44		45	14		60	Code, 1895.
Hawaii	60	56	32	48		56																								Penal Laws, 1897.
Idaho	60	56	36	48	42	56					60								45	28	28		56						60	Laws, 1899–1903.
Illinois	60	56	32	48	52	56	70	a48	20	38	60	50		57	55		60			24	33	46	56	44		45	14		60	Rev. Stat., 1899–1901.
Indiana	60	56	32	48	50	56	d68	a50		35	60	55		48	55		60			25	33	46		44	50	45	14		60	Rev. Stat., 1897.
Indian Territory																														
Iowa	60	56	32	48	52	56	70		20		60	46		57			60		48	24	33	46	56	44	50	45	14	50	60	Rev. Code, 1897, and Laws, 1902.
Kansas	60	56	32	48	50	56	70	a50	20	32	60	50		57	55		60		48	24	33	46	56	44	50	45	14	50	60	Gen. Stat., 1901.
Kentucky	60	56	32	47	56	56	e70	a50	20		60	55		57	60		60	60		24	39	45	56	44	50	45	14	50	60	Gen. Stat., 1888.
Louisiana	60	f32	32	f32		56																								Rev. Laws, 1884–1897.
Maine	60		30	48	48	56		50			60		50	52	50	60	60	60	44							45				Rev. Stat., 1883, Sup. 1895, Act, 1897.
Maryland			26								56																			Code, 1888, and Sup. 1890–1900.
Massachusetts	60	56	32	48	48	56		50	20		60	54	50	52			60	60	48	25	33		55		g35	45			60	Rev. Laws, 1902.
Michigan	60	56	32	48	48	56	70	a50			60	56		54	48		60	60	48	22	28	46	56	44	50	45	14	50	60	Com. Laws, 1897.
Minnesota	60	56	32	48	50	56	70				60	55	45	52	52	50	60	60	50	28	28			50	48	45	14	48	60	Rev. Stat., 1897.
Mississippi	60	56	32	48	48	56	72	a48	20	38	60	60		57	55		60	60		26	33	46	56	44	50	45	14	50	60	Code, 1892, and Act Mar. 12, 1900.
Missouri	60	56	32	48	52	56	70	a50	20	38	60	56	50	57	42		60	60	v48	24	33	46	56	44	50	45	14	48	60	Rev. Stat., 1899.
Montana	60	56	32	48	52	56	70	a50	20	30	60		50	57		50	60	60	h45				56	44		45	14	50	60	Stat., 1888, 1901.
Nebraska	60	56	32	48	52	56	70	a50	20	30	60	50		57	55		60	60		24	33	46	56	44	50	45	14	50	60	Com. Stat., 1901–1903.
Nevada																														
New Hampshire	60	56	32			56		50			60						62	60												Pub. Stat., 1901.

New Jersey	60	56	30	48	50	56	....	....	....	....	60	54	....	57	....	....	60	60	50	25	33	....	55	....	....	....	....	....	64	Gen. Stat., 1895.
New Mexico	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	
New York	60	56	32	48	48	56	....	50	20	....	60	54	50	57	....	....	60	60	48	25	33	....	55	....	....	45	....	....	60	Gen. Laws, 1902.
North Carolina	60	56	32	48	50	56	....	*a*48	....	....	....	....	....	....	....	....	....	60	....	....	....	....	55	....	....	....	....	....	60	Act, Jan. 31, 1885.
North Dakota	60	56	32	48	42	56	70	....	20	....	60	46	....	52	60	60	60	60	....	....	....	....	56	....	50	42	....	....	60	Code, 1899, and Act, Mar., 1901.
Ohio	60	56	32	48	50	56	68	....	....	34	60	50	50	55	60	56	60	60	50	24	33	....	56	44	50	45	....	50	60	Rev. Stat., 1902.
Oklahoma	60	56	32	48	42	56	70	....	20	....	60	46	....	52	60	60	60	60	....	....	....	....	56	....	....	42	....	....	60	Rev. Stat., 1903.
Oregon	60	56	32	46	42	56	....	....	....	....	60	....	....	....	....	....	....	....	45	28	28	....	....	....	....	....	....	....	60	Code, 1902.
Pennsylvania	60	56	32	47	48	56	....	....	....	....	56	....	....	50	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60	Digest, 1700-1901.
Philippines	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Metric system.
Porto Rico	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Do.
Rhode Island	60	56	32	48	48	56	70	50	20	38	60	54	50	50	50	50	60	60	48	25	33	46	56	44	50	45	....	50	60	Pub. Laws, 1900.
Samoa	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	English weights and measures.
South Carolina	....	....	....	....	....	....	....	*a*48	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Laws of 1903.
South Dakota	60	56	32	48	42	56	70	....	20	....	60	46	....	52	60	60	60	60	....	....	....	....	56	....	....	42	....	....	60	Stat., 1901.
Tennessee	60	56	32	48	50	56	70	*a*48	20	....	60	50	50	56	50	50	60	60	*x*50	24	26	46	56	44	50	45	14	48	60	Act, 1887.
Texas	60	56	32	48	42	56	70	....	20	....	60	55	....	57	55	....	60	....	*y*45	28	28	....	56	44	50	45	....	48	60	Act, Apr. 18, 1901.
Utah	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	
Vermont	60	56	32	48	48	56	....	....	....	....	60	....	50	52	60	60	62	60	*n*46	....	....	....	....	....	....	45	....	....	60	Stat., 1894.
Virginia	60	56	30	48	52	56	70	*a*50	....	38	56	56	....	57	55	....	60	60	45	28	*h*32	....	56	44	50	45	14	48	60	Code, 1887, and Act, Feb. 24, 1898.
Washington	60	56	32	48	42	56	....	....	....	....	60	....	....	....	....	....	....	....	45	28	28	....	56	....	....	....	....	....	60	Stat., 1897.
West Virginia	60	56	32	48	52	56	....	....	....	....	60	....	....	....	....	....	60	....	....	25	33	....	56	....	....	45	....	....	60	Code, 1899.
Wisconsin	60	56	32	48	50	56	70	50	20	34	60	54	50	57	42	50	60	60	*n*50	25	33	....	56	44	50	45	....	48	60	Stat., 1898, and Act, Mar. 30, 1901.
Wyoming	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	

a Applies only to unbolted corn meal.
b Peeled, 38.
c Velvet beans in hull, 78.
d Before Dec. 1, 70.
e May 1 to Nov. 1, 68.
f So in statutes, but an evident error.
g Japanese barnyard millet.
h Peeled, 40.

STATISTICS OF THE PRINCIPAL CROPS.[a]

CORN.

Corn crop of countries named, 1898–1902.

Country.	1898.	1899.	1900.	1901.	1902.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	1,924,185,000	2,078,144,000	2,105,103,000	1,522,520,000	2,523,648,000
Canada (Ontario)	24,181,000	22,356,000	27,947,000	25,621,000	21,159,000
Mexico	111,347,000	93,438,000	92,204,000	93,459,000	78,099,000
Total North America	2,059,713,000	2,193,938,000	2,225,254,000	1,641,600,000	2,622,906,000
Chile	9,932,000	9,000,000	8,000,000	9,000,000	9,000,000
Argentina	56,000,000	66,185,000	55,612,000	98,842,000	84,018,000
Uruguay	4,000,000	6,000,000	3,035,000	5,576,000	4,163,000
Total South America	69,932,000	81,185,000	66,617,000	113,418,000	97,181,000
France	23,496,000	25,548,000	22,232,000	26,393,000	23,000,000
Spain	14,098,000	24,667,000	26,016,000	23,000,000	22,000,000
Portugal	15,500,000	16,000,000	16,000,000	15,000,000	16,000,000
Austria	16,074,000	14,583,000	15,446,000	17,535,000	13,462,000
Hungary	127,382,000	115,981,000	127,656,000	127,389,000	101,546,000
Croatia-Slavonia	20,822,000	14,680,000	18,691,000	20,469,000	15,285,000
Total Austria-Hungary	164,278,000	145,244,000	161,793,000	165,393,000	133,293,000
Italy	79,640,000	88,536,000	83,286,000	100,455,000	71,028,000
Roumania	101,907,000	27,721,000	85,047,000	116,945,000	68,447,000
Bulgaria and E. Roumelia	37,759,000	20,462,000	18,000,000	25,000,000	18,109,000
Servia	24,558,000	15,000,000	18,472,000	25,000,000	22,000,000
Russia	47,918,000	30,912,000	34,256,000	68,400,000	48,649,000
Total Europe	509,154,000	394,090,000	465,102,000	565,586,000	422,526,000
Algeria	347,000	349,000	350,000	350,000	350,000
Egypt	32,000,000	30,000,000	25,000,000	30,000,000	30,000,000
Cape Colony	2,061,000	2,858,000	2,000,000	2,000,000	2,000,000
Total Africa	31,408,000	33,207,000	27,350,000	32,350,000	32,350,000
Australasia	9,412,000	9,780,000	10,025,000	10,168,000	7,847,000

RECAPITULATION BY CONTINENTS.

	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
North America	2,059,713,000	2,193,938,000	2,225,254,000	1,641,600,000	2,622,906,000
South America	69,932,000	81,185,000	66,647,000	113,418,000	97,181,000
Europe	509,154,000	394,090,000	465,102,000	565,586,000	422,526,000
Africa	34,408,000	33,207,000	27,350,000	32,350,000	32,350,000
Australasia	9,412,000	9,780,000	10,025,000	10,168,000	7,847,000
Total	2,682,619,000	2,712,200,000	2,794,378,000	2,363,122,000	3,182,810,000

[a] The figures in the following tables were furnished by the Bureau of Statistics, Department of Agriculture, except such as otherwise credited. All prices are on gold basis.

Visible supply of corn, United States and Canada, first of each month for ten years.[a]

Month.	1894–1895.	1895–1896.	1896–1897.	1897–1898.	1898–1899.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	7,793,000	10,762,000	11,199,000	21,501,000	32,983,000
August	4,816,000	5,770,000	13,246,000	20,018,000	25,430,000
September	4,295,000	6,819,000	18,608,000	37,528,000	24,043,000
October	5,206,000	6,760,000	17,800,000	45,412,000	30,132,000
November	3,353,000	6,338,000	23,913,000	52,980,000	33,198,000
December	6,380,000	7,381,000	22,635,000	49,559,000	25,870,000
January	12,882,000	9,164,000	26,457,000	48,292,000	26,936,000
February	16,733,000	17,035,000	29,725,000	53,522,000	36,726,000
March	17,001,000	17,040,000	33,764,000	52,457,000	44,792,000
April	16,330,000	19,290,000	32,670,000	52,228,000	43,618,000
May	11,602,000	13,239,000	21,707,000	34,734,000	34,236,000
June	12,629,000	11,231,000	16,161,000	28,288,000	19,070,000

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Visible supply of corn, United States and Canada, first of each month for ten years—Cont'd.

Month.	1899-1900.	1900-1901.	1901-1902.	1902-1903.	1903-1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	21,551,000	19,087,000	21,522,000	8,541,000	13,410,000
August	17,687,000	18,613,000	19,648,000	9,013,000	11,715,000
September	11,070,000	8,766,000	19,476,000	3,823,000	9,487,000
October	16,662,000	11,106,000	21,215,000	4,607,000	15,063,000
November	18,738,000	11,061,000	19,137,000	4,229,000	12,147,000
December	17,555,000	12,791,000	16,599,000	4,552,000	9,817,000
January	19,024,000	14,313,000	16,825,000	9,345,000	9,547,000
February	20,110,000	21,950,000	17,197,000	11,535,000	12,807,000
March	28,340,000	27,538,000	15,270,000	15,180,000	16,669,000
April	31,883,000	28,947,000	13,540,000	16,901,000	16,571,000
May	30,416,000	24,544,000	9,093,000	9,454,000	....
June	18,289,000	21,904,000	6,317,000	7,039,000	....

Condition of the corn crop of the United States, monthly, 1889-1903.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
1889	90.3	94.8	90.9	91.7	1894	95.0	69.1	63.4	64.2	1899	86.5	89.9	85.2	82.7
1890	93.1	73.3	70.1	70.6	1895	99.3	102.5	96.4	95.5	1900	89.5	87.5	80.6	78.2
1891	92.8	90.8	91.1	92.5	1896	92.4	96.0	91.0	90.5	1901	81.3	54.0	51.7	52.1
1892	81.1	82.5	79.6	79.8	1897	82.9	84.2	79.3	77.1	1902	87.5	86.5	84.3	79.6
1893	93.2	87.0	76.7	75.1	1898	90.5	87.0	84.1	82.0	1903	79.4	78.7	80.1	80.8

Acreage, production, value, prices, and exports of corn of the United States, 1866-1903.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including corn meal, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1866	34,306,538	25.3	867,946,295	47.4	411,450,830	53	62	64	79	16,026,947
1867	32,520,249	23.6	768,320,000	57.0	437,769,763	61	65	61	71	12,493,522
1868	34,887,246	26.0	906,527,000	46.8	424,056,649	38	58	44	51	8,286,665
1869	37,103,245	23.6	874,320,000	59.8	522,550,509	56	67	73	85	2,140,487
1870	38,646,977	28.3	1,094,255,000	49.4	540,520,456	41	59	46	52	10,676,873
1871	34,091,137	29.1	991,898,000	43.4	430,355,910	36	39	38	43	35,727,010
1872	35,526,836	30.8	1,092,719,000	35.3	385,736,210	27	28	34	39	40,154,374
1873	39,197,148	23.8	932,274,000	44.2	411,961,151	40	49	49	59	35,985,834
1874	41,036,918	20.7	850,148,500	58.4	496,271,255	64	76	53	67	30,025,036
1875	44,841,371	29.5	1,321,069,000	36.7	484,674,804	40	47	41	45	50,910,532
1876	49,033,364	26.2	1,283,827,500	34.0	436,108,521	40	43	43	56	72,652,611
1877	50,369,113	26.7	1,342,558,000	34.8	467,635,230	41	49	35	41	87,192,110
1878	51,585,000	26.9	1,388,218,750	31.7	440,280,517	30	32	33	36	87,884,892
1879	53,085,450	29.2	1,547,901,790	37.5	580,486,217	39	43¼	32⅜	36⅛	99,572,329
1880	62,317,842	27.6	1,717,434,543	39.6	679,714,499	35⅝	42	41⅛	45	93,648,147
1881	64,262,025	18.6	1,194,916,000	63.6	759,482,170	58½	63⅛	69	76⅞	44,340,683
1882	65,659,545	24.6	1,617,025,100	48.5	783,867,175	49¼	61	53¼	56¾	41,655,653
1883	68,301,889	22.7	1,551,066,895	42.4	658,051,485	54¼	63⅛	52⅛	57	46,258,606
1884	69,683,780	25.8	1,795,528,432	35.7	640,735,859	34½	40¼	44¾	49	52,876,456
1885	73,130,150	26.5	1,936,176,000	32.8	635,674,630	36	42¾	34¼	36¾	64,829,617
1886	75,694,208	22.0	1,665,441,000	36.6	610,311,000	35¾	38	36⅞	39⅜	41,368,584
1887	72,392,720	20.1	1,456,161,000	44.4	646,106,770	47	51⅛	54	60	25,360,869
1888	75,672,763	26.3	1,987,790,000	34.1	677,561,580	33½	35⅞	33⅛	35⅜	70,841,673
1889	78,319,651	27.0	2,112,892,000	28.3	597,918,829	29¼	35	32¾	35	103,418,709
1890	71,970,763	20.7	1,489,970,000	50.6	754,433,451	47¾	53	55	69½	32,041,529
1891	76,204,515	27.0	2,060,154,000	40.6	836,439,228	39⅜	59	40¾	a100	76,602,285
1892	70,626,658	23.1	1,628,464,000	39.4	642,146,630	40	42⅞	39½	44½	47,121,894
1893	72,036,465	22.5	1,619,496,131	36.5	591,625,627	34¼	36½	36¾	38½	66,489,529
1894	62,582,269	19.4	1,212,770,052	45.7	554,719,162	44¾	47½	47¾	55½	28,585,405
1895	82,075,830	26.2	2,151,138,580	25.3	544,985,534	25	26¾	27½	29½	101,100,375
1896	81,027,156	28.2	2,283,875,165	21.5	491,006,967	22½	23¾	23	25⅛	178,817,417
1897	80,095,051	23.8	1,902,967,933	26.3	501,072,952	25	27½	32⅜	37	212,055,543
1898	77,721,781	24.8	1,924,184,660	28.7	552,023,428	33⅛	38	32⅛	34⅜	177,255,046
1899	82,108,587	25.3	2,078,143,933	30.3	629,210,110	30	31½	36	40½	213,123,412
1900	83,320,872	25.3	2,105,102,516	35.7	751,220,034	35¼	40½	42⅝	58½	181,405,473
1901	91,349,928	16.7	1,522,519,891	60.5	921,555,768	62½	67½	59⅛	64¾	28,028,688
1902	94,043,613	26.8	2,523,648,312	40.3	1,017,017,349	43¾	57¼	44	46	76,639,261
1903	88,091,993	25.5	2,244,176,925	42.5	952,868,801	41	43¾	......	......	....

a Coincident with "corner."

Acreage, production, value, and distribution of corn of the United States, in 1903, by States.

States and Territories.	Crop of 1903. Acreage.	Crop of 1903. Production.	Crop of 1903. Value.	Stock in farmers' hands Mar. 1, 1904.		Shipped out of county where grown.
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	14,626	411,705	291,525	57,422	13.0	....
New Hampshire	29,049	610,029	384,318	146,407	24.0	....
Vermont	60,027	1,404,632	870,872	294,973	21.0	....
Massachusetts	44,803	1,075,272	709,680	193,549	18.0	....
Rhode Island	10,012	301,361	244,102	51,231	17.0	3,014
Connecticut	55,056	1,233,254	826,280	320,646	26.0	....
New York	619,421	15,485,525	9,291,315	4,645,658	30.0	309,711
New Jersey	272,276	6,534,624	3,724,736	2,025,733	31.0	261,385
Pennsylvania	1,456,655	45,447,636	25,905,153	14,543,244	32.0	1,363,429
Delaware	185,263	5,094,732	2,496,419	2,802,103	55.0	2,190,736
Maryland	622,692	17,871,260	9,114,343	7,327,217	41.0	5,182,665
Virginia	1,822,968	39,740,702	21,062,572	17,088,502	43.0	4,371,477
North Carolina	2,625,482	38,594,585	23,542,697	16,981,617	44.0	771,892
South Carolina	1,807,579	18,618,064	12,846,464	8,005,768	43.0	558,542
Georgia	3,938,324	46,078,391	31,794,090	22,117,628	48.0	2,303,920
Florida	614,448	6,083,035	4,440,616	2,554,875	42.0	301,152
Alabama	2,820,011	41,736,163	23,789,613	22,120,166	53.0	1,669,447
Mississippi	2,165,667	39,848,273	21,518,067	21,916,550	55.0	1,195,448
Louisiana	1,356,209	27,937,905	16,203,985	10,337,025	37.0	558,758
Texas	5,816,146	140,750,733	67,560,352	57,707,801	41.0	16,890,088
Arkansas	2,306,826	48,212,663	24,588,458	20,249,318	42.0	3,857,013
Tennessee	3,203,565	75,283,778	36,889,051	31,619,187	42.0	12,045,404
West Virginia	743,099	16,794,037	10,748,184	5,542,032	33.0	839,702
Kentucky	3,103,216	82,545,546	46,225,506	33,018,218	40.0	7,429,099
Ohio	2,976,208	88,095,757	41,405,006	29,071,600	33.0	17,619,151
Michigan	1,319,768	44,212,228	20,337,725	15,474,280	35.0	3,536,978
Indiana	4,294,605	142,580,886	51,329,119	54,180,737	38.0	41,348,457
Illinois	8,201,473	264,087,431	95,071,475	108,275,847	41.0	129,402,841
Wisconsin	1,489,401	43,639,449	18,764,963	12,219,046	28.0	1,745,578
Minnesota	1,439,112	40,726,870	15,476,211	11,403,524	28.0	2,850,881
Iowa	8,186,365	229,218,220	87,102,924	68,765,466	30.0	13,753,093
Missouri	6,260,481	202,839,584	68,965,459	73,022,250	36.0	22,312,354
Kansas	6,706,524	171,687,014	61,807,325	61,807,325	36.0	41,204,883
Nebraska	6,629,982	172,379,532	48,266,269	63,780,427	37.0	68,951,813
South Dakota	1,530,076	41,618,067	14,566,323	14,566,323	35.0	7,491,252
North Dakota	86,008	2,167,402	910,309	390,132	18.0	65,022
Montana	3,788	91,291	56,600	18,258	20.0	913
Wyoming	2,360	45,784	26,555	2,747	6.0	....
Colorado	112,226	2,222,075	1,199,920	466,636	21.0	44,441
New Mexico	39,862	956,688	717,516	306,140	32.0	47,834
Arizona	8,702	194,925	175,432	37,036	19.0	1,949
Utah	11,134	238,268	166,788	40,506	17.0	2,383
Idaho	5,091	175,640	100,115	26,346	15.0	....
Washington	9,914	229,013	125,957	41,222	18.0	2,290
Oregon	17,386	448,559	300,535	85,226	19.0	8,971
California	57,888	1,777,162	1,315,100	266,574	15.0	319,889
Oklahoma	1,491,339	34,748,199	13,204,316	7,992,086	23.0	2,432,374
Indian Territory	1,518,880	42,072,976	16,408,461	15,146,271	36.0	4,628,027
United States	88,091,993	2,244,176,925	952,868,801	839,052,875	37.4	419,877,256

Average yield per acre of corn in the United States, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	39.9	42.0	37.0	37.0	40.0	36.0	36.0	39.4	21.7	30.2
New Hampshire	34.3	40.2	42.0	34.0	41.0	39.0	37.0	38.5	23.3	21.0
Vermont	40.8	45.6	41.0	35.0	43.0	36.0	40.0	40.0	21.8	23.4
Massachusetts	34.5	43.9	43.0	32.5	40.0	36.0	38.0	40.5	31.3	24.0
Rhode Island	31.4	30.9	34.0	31.0	34.0	31.0	32.0	32.1	28.4	30.1
Connecticut	31.0	37.9	38.0	31.5	37.0	39.0	38.0	39.0	31.5	22.4
New York	28.2	35.6	34.0	31.0	33.0	31.0	32.0	33.0	25.0	25.0
New Jersey	33.1	33.0	33.0	31.5	37.0	39.0	33.0	36.9	34.5	24.0
Pennsylvania	32.0	33.5	40.0	36.0	37.0	32.0	25.0	35.0	36.1	31.2
Delaware	22.0	21.0	22.0	29.0	25.0	22.0	24.0	30.0	28.0	27.5
Maryland	22.9	26.8	32.0	33.0	31.0	32.0	26.0	34.2	32.4	28.7
Virginia	19.1	18.6	21.5	18.0	22.0	20.0	16.0	22.2	22.0	21.8
North Carolina	13.4	14.5	12.0	13.0	14.0	13.0	12.0	12.0	13.9	14.7
South Carolina	11.2	11.1	9.0	9.0	10.0	9.0	7.0	6.9	10.4	10.3
Georgia	11.7	13.0	11.0	11.0	9.0	10.0	10.0	10.0	9.0	11.7
Florida	10.1	11.2	10.0	8.0	9.0	10.0	8.0	9.0	8.6	9.9
Alabama	13.7	15.9	12.5	12.0	15.0	12.0	11.0	10.9	8.4	14.8
Mississippi	17.2	15.8	13.5	14.5	18.0	16.0	11.0	10.9	11.5	18.4
Louisiana	16.2	18.8	13.0	17.0	18.0	18.0	17.0	13.7	12.5	20.6
Texas	19.0	26.4	9.5	18.5	25.0	18.0	18.0	11.6	8.1	24.2
Arkansas	19.2	21.5	13.5	16.0	20.0	20.0	19.0	8.1	21.3	20.9
Tennessee	21.9	25.0	23.0	21.0	26.0	20.0	20.0	14.2	21.9	23.5
West Virginia	18.5	24.2	30.0	24.5	29.0	26.0	27.0	23.0	26.5	22.6
Kentucky	23.0	31.2	28.0	23.0	31.0	21.0	26.0	15.6	27.0	26.6

Average yield per acre of corn in the United States, 1894–1903, by States—Continued.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Ohio	26.3	32.6	41.0	32.5	37.0	36.0	37.0	26.1	38.0	29.6
Michigan	23.2	33.8	38.0	31.5	34.0	25.0	36.0	34.5	26.4	33.5
Indiana	28.9	32.8	35.0	30.0	36.0	38.0	38.0	19.8	37.9	33.2
Illinois	28.8	37.4	40.5	32.5	30.0	36.0	37.0	21.4	38.7	32.2
Wisconsin	20.7	31.8	37.0	33.0	35.0	35.0	40.0	27.4	28.2	29.3
Minnesota	18.4	31.2	30.5	26.0	32.0	33.0	33.0	26.3	22.8	28.3
Iowa	15.0	35.1	39.0	29.0	35.0	31.0	38.0	25.0	32.0	28.0
Missouri	22.0	36.0	27.0	26.0	26.0	26.0	28.0	10.1	39.0	32.4
Kansas	11.2	24.3	28.0	18.0	16.0	27.0	19.0	7.8	29.9	25.6
Nebraska	6.0	16.1	37.5	30.0	21.0	28.0	26.0	14.1	32.3	26.0
South Dakota	4.2	11.1	26.0	24.0	28.0	26.0	27.0	21.0	18.9	27.2
North Dakota	19.2	21.3	35.0	17.0	19.0	23.0	16.0	22.6	19.4	25.2
Montana	32.7	25.0	26.0	18.0	28.0	23.0	15.0	25.0	22.0	24.1
Wyoming	30.0	27.5	25.0	12.0	16.0	22.0	34.0	39.5	19.8	19.4
Colorado	19.7	20.7	16.0	19.0	18.0	17.0	19.0	17.1	16.5	19.8
New Mexico	19.1	27.2	16.0	27.0	21.0	20.0	22.0	31.6	22.0	21.0
Arizona								18.0	20.2	22.4
Utah	24.4	20.3	25.0	22.0	21.0	20.0	20.0	19.4	20.1	21.4
Idaho								23.0	21.7	34.5
Washington	20.8	17.1	14.0	18.0	12.0	23.0	20.0	17.5	23.0	23.1
Oregon	25.4	26.4	22.0	25.0	24.0	22.0	23.0	20.8	23.4	25.8
California	19.3	34.5	37.0	31.5	26.0	27.0	25.0	31.0	30.5	30.7
Oklahoma						19.0	26.0	7.3	25.8	23.3
Indian Territory								12.0	24.9	27.7
General average	19.4	26.2	28.2	23.8	24.8	25.3	25.3	16.7	26.8	25.5

Average value per acre of corn in United States, based upon farm value Dec. 1, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$28.73	$22.68	$17.39	$17.39	$19.20	$18.00	$19.80	$29.94	$16.06	$19.93
New Hampshire	26.07	20.50	18.90	15.30	18.86	19.11	20.72	30.03	17.01	13.23
Vermont	28.15	21.89	15.58	15.05	18.92	16.92	20.00	29.20	14.82	14.51
Massachusetts	21.05	22.83	19.78	15.28	19.60	18.36	20.52	30.78	23.16	15.84
Rhode Island	23.55	17.30	16.66	16.74	21.76	16.43	21.44	24.40	22.15	24.38
Connecticut	21.08	19.33	15.96	15.43	19.24	19.50	20.90	29.25	23.31	15.01
New York	17.20	16.02	12.92	12.40	14.19	13.95	15.04	23.76	16.75	15.00
New Jersey	17.87	13.86	11.88	11.97	14.80	15.60	14.85	24.35	19.32	13.68
Pennsylvania	17.60	13.07	13.20	22.24	14.80	13.12	11.25	21.70	20.94	17.78
Delaware	9.90	7.14	5.50	8.70	7.75	7.48	9.12	17.10	13.72	13.48
Maryland	11.45	9.92	10.24	9.90	10.85	11.52	10.66	19.84	16.52	14.64
Virginia	8.98	6.88	6.88	6.84	7.70	7.60	7.84	13.10	11.44	11.55
North Carolina	6.30	5.51	4.44	5.59	6.02	6.11	6.84	8.76	8.31	8.97
South Carolina	7.28	5.11	4.14	4.41	4.60	4.50	4.48	5.80	7.18	7.11
Georgia	6.79	5.33	4.73	5.28	4.32	5.00	5.70	8.20	6.57	8.07
Florida	7.17	5.26	5.30	4.40	4.50	5.30	4.80	7.65	6.62	7.23
Alabama	7.26	5.88	5.63	5.52	6.15	5.61	6.38	8.39	5.63	8.44
Mississippi	8.43	5.85	5.94	6.53	7.02	7.36	6.38	8.07	7.02	9.94
Louisiana	10.04	7.24	5.85	7.65	7.38	7.92	8.50	10.27	8.25	11.95
Texas	10.64	8.18	3.90	7.58	8.50	6.48	8.46	9.28	5.35	11.62
Arkansas	9.02	6.88	4.99	6.40	5.80	7.60	8.17	6.56	10.44	10.66
Tennessee	8.54	6.75	6.44	7.56	7.54	7.80	9.80	9.23	10.29	11.52
West Virginia	10.55	9.68	10.20	9.80	10.73	11.70	13.50	14.95	14.31	14.46
Kentucky	10.12	8.42	7.00	8.05	8.37	7.77	10.40	9.52	11.34	14.90
Ohio	11.31	8.80	8.61	8.12	9.99	10.80	12.58	14.88	15.96	13.91
Michigan	11.60	10.82	9.12	8.50	11.56	9.00	13.32	17.94	13.73	15.41
Indiana	10.69	7.54	6.65	6.30	9.00	10.26	12.16	10.89	13.64	11.95
Illinois	11.23	8.23	7.29	6.83	7.50	9.36	11.84	12.20	13.93	11.59
Wisconsin	9.32	9.54	8.14	8.25	9.80	10.50	13.20	14.25	14.10	12.60
Minnesota	7.91	6.24	5.79	6.21	7.68	7.92	9.57	11.83	9.12	10.75
Iowa	6.75	6.32	5.46	4.93	8.05	7.13	10.26	13.00	10.56	10.64
Missouri	8.80	7.20	5.40	6.24	7.02	7.80	8.96	6.77	12.87	11.02
Kansas	4.82	4.62	5.04	3.96	4.16	6.75	6.08	4.91	10.17	9.22
Nebraska	3.00	2.90	4.88	5.10	4.62	6.44	8.06	7.61	9.69	7.28
South Dakota	1.93	2.55	4.68	5.04	6.44	6.76	7.83	9.45	7.75	9.52
North Dakota	8.45	5.11	8.75	5.44	6.81	7.59	6.72	10.40	8.73	10.58
Montana	26.81	18.75	15.60	11.70	18.48	11.96	8.85	22.50	15.84	14.94
Wyoming	19.50	15.67	19.50	6.00	8.80	9.46	20.40	28.44	11.68	11.25
Colorado	12.02	8.49	5.76	7.22	7.20	7.31	9.12	12.65	9.73	10.69
New Mexico	14.33	15.23	8.80	15.66	11.76	11.60	14.08	24.33	17.16	18.00
Arizona								16.20	20.40	20.16
Utah	14.15	9.95	12.75	12.10	12.60	11.80	12.60	17.46	13.47	14.98
Idaho								13.80	15.31	19.67
Washington	14.35	6.81	7.98	9.90	5.04	12.65	11.80	10.15	14.95	12.70
Oregon	14.22	14.52	12.32	13.25	11.40	14.08	13.11	11.86	15.44	17.29
California	11.00	18.29	19.61	17.64	16.12	16.20	15.25	21.08	23.49	22.72
Oklahoma						3.80	6.76	5.55	10.06	8.85
Indian Territory								9.12	10.71	10.80
General average	8.86	6.64	6.06	6.26	7.10	7.66	9.02	10.09	10.81	10.82

Average farm price of corn per bushel in the United States, December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	72	54	47	47	48	50	55	76	74	66
New Hampshire	76	51	45	45	46	49	56	78	73	63
Vermont	69	48	38	43	44	47	50	73	68	62
Massachusetts	61	52	46	47	49	51	54	76	74	66
Rhode Island	75	56	49	54	64	53	67	76	78	81
Connecticut	68	51	42	49	52	50	55	75	74	67
New York	61	45	38	40	43	45	47	72	67	60
New Jersey	54	42	36	38	40	40	45	66	56	57
Pennsylvania	55	39	33	34	40	41	45	62	58	57
Delaware	45	34	25	30	31	34	38	57	49	49
Maryland	50	37	32	30	35	36	41	58	51	51
Virginia	47	37	32	38	35	38	49	59	52	53
North Carolina	47	38	37	43	43	47	57	73	60	61
South Carolina	65	46	46	49	46	50	64	81	69	69
Georgia	58	41	43	48	48	50	57	82	73	69
Florida	71	47	53	55	50	53	60	85	77	73
Alabama	53	37	45	46	41	47	58	77	67	57
Mississippi	49	37	44	45	39	46	58	74	61	54
Louisiana	62	40	45	45	41	44	50	75	66	58
Texas	56	31	41	41	34	36	47	80	66	48
Arkansas	47	32	37	40	29	38	43	81	49	51
Tennessee	39	27	28	36	29	39	49	65	47	49
West Virginia	57	40	31	40	37	45	50	65	54	64
Kentucky	44	27	25	35	27	37	40	61	42	56
Ohio	43	27	21	25	27	30	34	57	42	47
Michigan	50	32	24	27	34	36	37	52	52	46
Indiana	37	23	19	21	25	27	32	55	36	36
Illinois	39	22	18	21	25	26	32	57	36	36
Wisconsin	45	30	22	25	28	30	33	52	50	43
Minnesota	43	20	19	24	24	24	29	45	40	38
Iowa	45	18	14	17	23	23	27	52	33	38
Missouri	40	20	20	24	27	30	32	67	33	34
Kansas	43	19	18	22	26	25	32	63	34	36
Nebraska	50	18	13	17	22	23	31	54	30	28
South Dakota	46	23	18	21	23	26	29	45	41	35
North Dakota	44	24	25	32	36	33	42	46	45	42
Montana	82	75	60	65	66	52	59	90	72	62
Wyoming	65	57	78	50	55	43	60	72	59	58
Colorado	61	41	36	38	40	43	48	74	59	54
New Mexico	75	56	55	58	56	58	64	77	78	75
Arizona	100	75	......	......	......	......	......	90	101	90
Utah	58	49	51	55	60	59	63	90	67	70
Idaho	......	......	......	......	......	......	......	60	62	57
Washington	69	40	57	55	42	55	59	58	65	55
Oregon	56	55	56	53	60	64	57	57	66	67
California	57	53	53	56	62	60	61	68	77	74
Oklahoma	......	......	......	......	......	20	26	76	39	38
Indian Territory	......	......	......	......	......	......	......	76	43	39
General average	45.7	25.3	21.5	26.3	28.7	30.3	35.7	60.5	40.3	42.5

Transportation rates, average for corn, in cents, St. Louis to New Orleans, by river.

Year.	Per bushel.		Year.	Per bushel.		Sacks per 100 lbs.	Year.	Per bushel.		Sacks per 100 lbs.	Year.	Sacks per 100 lbs.
	Low water.	High water.		Low water.	High water.			Low water.	High water.			
1868	6.23	9.84	1877	7.63	8.59	20.01	1886	5.00	7.00	16.00	1895	13.00
1869	6.32	8.42	1878	4.96	8.93	17.36	1887	5.00	7.00	18.25	1896	14.54
1870	9.23	13.66	1879	5.00	11.00	18.00	1888	5.00	7.50	15.00	1897	10.83
1871	6.71	16.29	1880	7.00	9.50	19.00	1889	5.00	7.00	17.93	1898	10.00
1872	9.79	19.04	1881	4.00	8.00	20.00	1890	5.00	7.00	15.66	1899	10.00
1873	6.15	9.67	1882	5.50	7.00	20.00	1891	5.00	7.50	16.28	1900	10.00
1874	4.95	8.09	1883	5.00	7.00	17.75	1892	5.00	7.00	16.87	1901	10.00
1875	4.87	10.01	1884	5.00	7.00	14.00	1893	......	......	17.51	1902	10.00
1876	5.02	11.30	1885	5.00	7.00	15.00	1894	......	......	17.14	1903	10.00

Wholesale prices of corn per bushel in leading cities of the United States, 1898–1903.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Francisco.	
	No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1898.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	33	35½	29	35¾	28½	30	26	28¼	28½	30	25¼	26¾	$0.85	$0.97½
February	34¼	37¼	32	36	29	32	27¼	30⅝	28¾	33½	26	28½	.97½	1.10
March	31¼	36¼	32½	35	31	32	28⅛	29¾	29½	32	26½	27⅞	1.05	1.10
April	34⅜	40⅝	34	42	31	37	28⅞	35¼	31	36½	27	32¾	1.10	1.15
May	36¾	41⅞	36¾	42½	35½	39	32⅜	37	35	39½	32	35½	1.10	1.12½
June	35⅛	38⅜	35¼	37½	33	35	31	33¾	31¾	36	30	32½	1.05	1.12½
July	35½	38¾	35	42	34	36¾	31¾	35½	32	36	30½	33¾	1.07½	1.12½
August	35	38	33	41	30	35½	29¾	33¾	32	35½	28¼	33	1.10	1.17½
September	34	35½	34	36½	30	31	29⅛	31⅝	30½	32½	28½	29⅝	1.12½	1.15
October	34¼	38¾	34	38	30¼	35	28¾	32⅞	30	35½	29	32½	1.05	1.15
November	37½	39¼	32	39	34	36½	31⅝	34⅛	34	36	30	32½	1.05	1.07½
December	38⅞	44¼	36	43½	33½	38	33⅛	38	34	38	31¾	36¼	1.05	1.15
1899.														
January	41⅞	45⅜	39½	41⅝	35½	38	35¼	38½	37	38	34¾	36¼	1.12	1.15
February	42¼	45	37¾	42	33	37	33½	37	35½	37	33	35	Nominal.	
March	41	45⅛	36	39⅜	35	37½	33	36⅛	34½	36½	33	34¾	Nominal.	
April	41	45½	38	43	36½	37½	34	35½	35½	37½	33½	35	1.15	1.17½
May	39¼	43½	36¾	38¾	34	36½	32½	34⅜	34½	35½	31½	34½	1.17½	1.17½
June	40⅛	42⅝	37	39½	35	36½	33¼	35½	34½	35	32	33½	1.15	1.17½
July	37⅝	41½	35	38¾	35	36½	31	34⅞	34	35½	31½	33½	1.15	1.15
August	36½	41¼	34¾	37½	32	34½	30½	33	33½	35	30	31½	1.10	1.12½
September	38⅝	41⅝	36½	40½	33¾	35	31¼	35	33¼	35½	30	31	1.07½	1.07½
October	39¾	42⅜	37½	39¼	34	36	31	33	34½	36½	30½	31¾	Nominal.	
November	39⅝	41¾	37½	39¾	31½	35	30¾	33¼	33	35½	30	31½	Nominal.	
December	39⅜	40⅞	36⅜	38⅝	31½	34	30	31½	32	33½	29½	31	1.05	1.05
1900.			Mixed.											
January	39⅞	42¼	36⅝	37¾	32¾	36	30½	31⅝	32½	34	30½	31	1.00	1.00
February	39⅞	44⅛	36¾	40⅜	33¼	36	31½	34¼	33½	35½	30½	33½	1.00	1.00
March	40⅞	46	38	42⅞	36	40¾	33⅜	38¼	36	40½	33½	37½	1.02½	1.10
April	45⅝	49¾	42⅝	45½	41	43½	38¼	40⅞	40	43½	37½	39¾	1.07½	1.10
May	41	47⅛	40⅝	45	40½	44	36	40½	39¼	41	36⅜	40½	1.02½	1.07½
June	42¾	50⅝	41⅜	48	39¾	45	37⅜	43½	39¾	45	37	42	1.02½	1.17½
July	44	52½	42⅜	48	41½	47	38⅜	44¾	40¾	45	37½	43	1.17½	1.17½
August	42⅞	47¾	41¾	45	41	43	37¼	41¼	42½	43¾	37½	40	1.22½	1.30
September	45	50⅜	44¼	47	42½	44	38⅞	43¼	43½	44	38¾	40½	Nominal.	
October	46	49¾	42	47	37	43	36½	41¾	41	43½	34	39	1.25	1.27½
November	45¾	47½	42¼	44½	37	40	35	49½	38¾	41	34¼	35¾	1.20	1.25
December	44¾	48	41⅞	44¼	37¾	39½	35¼	40½	38	39½	33¾	36	1.20	1.20

Wholesale prices of corn per bushel in leading cities of the United States, 1898–1903—Continued.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Francisco.	
	No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	45½	48½	41½	43¼	38	40	36	37¾	38	39½	35	37	$1.12½	$1.15
February	47½	49	42¼	45	39½	42¼	37¼	40	39¼	40½	37½	40	1.10	1.20
March	48¼	50½	44¼	48¼	41½	42¾	39	44	40	43	38¾	43	1.15	1.32½
April	48¼	53¾	46⅛	49¾	44½	47	41	48	43	45½	41	46¼	1.15	1.35
May	49	56	46¾	50¼	43¼	46½	42⅝	58½	42¼	46	42	45⅝	1.20	1.35
June	46¼	49¾	44⅛	47¾	43½	44½	41	44⅜	42	45	41¼	44	1.25	1.37½
July	50½	61¼	46¼	59	45	58	43½	58¼	44½	56½	43¾	60½	1.50	1.75
August	60	64	56½	63½	57½	64	53¾	59½	37	39½	55¼	63	1.65	1.70
September	61½	66⅛	59¾	62	56½	61½	54½	59¾	55¾	59½	55¾	60	1.55	1.65
October	60⅞	64	58¼	61	60	60½	54⅝	58	57½	60	57	61	1.62½	1.70
November	63½	69½	60¾	67	63	66	57⅛	63⅞	60	66½	60½	66½	1.40	1.60
December	69¼	72⅞	65	68	66½	71½	62½	67½	66½	70½	65½	70	1.30	1.40
1902.														
January	66	72¼	58½	69½	62	68½	56½	64½	57	67¾	59	69¼	1.30	1.45
February	66½	71¼	60¼	68½	61	64½	56⅜	61¼	59	62	58½	63	1.35	1.45
March	65	71½	63	68	62	64	56	61⅛	59	61½	59	63	1.35	1.42½
April	65½	73	63½	69	60½	67½	56¾	64½	59½	64½	59¾	67	1.40	1.45
May	66⅞	73	66½	70	64	67¼	59½	61¾	63½	65½	62½	66	1.55	1.60
June	68¾	71½	67½	72	63½	66½	61	71½	63¼	66½	62	67	1.55	1.65
July	65¾	73	67	77	63½	69	56	88	66	67	61	66	1.52½	1.60
August	63½	69½	59	67	58	64	54	60	66	67	54	61½	1.45	1.60
September	67½	72½	64	69	60	63½	57	62½	55¾	59½	56½	60½	1.45	1.65
October	67½	70½	65	69	60	62½	55	61½	57½	60	56	58½	1.45	1.60
November	61½	67	47	68	45	60	52¾	58	60	66½	44½	49	1.42½	1.60
December	57	64	43½	55¼	44	50	43¾	57¼	66½	70½	40½	49½	1.47½	1.65
1903.														
January	55	68½	51½	60	43½	48½	43¾	48⅛	47	49	40	44½	....	....
February	55¾	59	52½	55	46	48	42½	45	47	48	41	44¾	....	....
March	50⅞	56¼	47¾	52¾	41½	47	41⅜	45⅝	40½	47½	39	45	....	....
April	51	53½	48½	52½	40	46	41¾	45¼	41½	45½	39½	42½	....	....
May	52¾	55	51	55½	45½	47¾	44	46	46½	48	41½	47½	....	....
June	56	60⅝	54½	59	48½	54	47¼	52	49½	55	48	55	....	....
July	56½	60	58½	61	50	53	49	53	51	55½	48	51¾	....	....
August	58¼	60¼	58	60	52½	54½	50½	53	54½	55½	48	51½	....	....
September	53¼	59¾	56	60	48	53	45¼	52¾	51	56½	45	50	....	....
October	51¼	54	53	55	45½	49	43½	46	47½	51½	41½	45	....	....
November	49¼	52⅝	46½	54½	45½	46	41⅜	44¾	46½	48½	41½	43¼	....	....
December	49½	53½	46¾	49¼	44½	46	41	43¾	44	48½	41½	45	....	....

Monthly average prices of corn in Chicago.[a]

[Cents per bushel.]

Month.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	$38\frac{3}{16}$	$42\frac{5}{8}$	$34\frac{7}{8}$	43	$26\frac{7}{8}$	$22\frac{9}{16}$	$27\frac{1}{8}$	$36\frac{11}{16}$	$31\frac{1}{16}$	$36\frac{7}{8}$	$60\frac{1}{2}$	$45\frac{15}{16}$
February	$40\frac{1}{8}$	42	$34\frac{11}{16}$	$42\frac{1}{8}$	$28\frac{7}{16}$	$22\frac{1}{2}$	$28\frac{15}{16}$	$35\frac{1}{4}$	$32\frac{7}{8}$	$38\frac{5}{8}$	$58\frac{15}{16}$	$43\frac{3}{4}$
March	$39\frac{1}{16}$	$40\frac{13}{16}$	$35\frac{3}{4}$	$44\frac{3}{8}$	$28\frac{5}{8}$	$23\frac{3}{4}$	$28\frac{15}{16}$	$34\frac{9}{16}$	$35\frac{13}{16}$	$41\frac{1}{2}$	$58\frac{9}{16}$	$43\frac{1}{2}$
April	$40\frac{5}{8}$	$40\frac{3}{4}$	$37\frac{7}{8}$	$46\frac{15}{16}$	$29\frac{5}{8}$	$24\frac{3}{16}$	$32\frac{1}{16}$	$34\frac{3}{4}$	$39\frac{9}{16}$	$44\frac{1}{2}$	$60\frac{5}{8}$	$43\frac{1}{2}$
May	$70\frac{3}{8}$	42	$37\frac{5}{8}$	$51\frac{5}{8}$	$28\frac{1}{2}$	$24\frac{1}{4}$	$34\frac{11}{16}$	$33\frac{7}{16}$	$38\frac{1}{4}$	$50\frac{9}{16}$	$61\frac{15}{16}$	45
June	51	$39\frac{9}{16}$	$39\frac{15}{16}$	50	$27\frac{3}{8}$	$24\frac{7}{16}$	$32\frac{3}{8}$	$34\frac{3}{8}$	$40\frac{7}{16}$	$42\frac{11}{16}$	$66\frac{1}{4}$	$49\frac{5}{8}$
July	$49\frac{5}{8}$	$38\frac{11}{16}$	$43\frac{1}{2}$	$44\frac{5}{8}$	26	$26\frac{7}{16}$	$33\frac{5}{8}$	$32\frac{15}{16}$	$41\frac{9}{16}$	$50\frac{7}{8}$	72	51
August	$51\frac{13}{16}$	$38\frac{3}{16}$	$53\frac{1}{16}$	$40\frac{3}{8}$	$22\frac{3}{4}$	$29\frac{3}{8}$	$31\frac{3}{4}$	$31\frac{3}{4}$	$39\frac{1}{4}$	$56\frac{5}{8}$	57	$51\frac{3}{4}$
September	$46\frac{3}{16}$	$39\frac{7}{8}$	53	$33\frac{15}{16}$	$20\frac{7}{8}$	$29\frac{5}{8}$	$30\frac{1}{4}$	$33\frac{1}{8}$	$41\frac{1}{16}$	$56\frac{15}{16}$	$59\frac{3}{4}$	49
October	$42\frac{3}{8}$	39	$50\frac{11}{16}$	$30\frac{3}{8}$	$24\frac{3}{8}$	$26\frac{1}{2}$	$30\frac{13}{16}$	32	$39\frac{1}{8}$	$56\frac{15}{16}$	$58\frac{1}{4}$	$44\frac{3}{4}$
November	$41\frac{13}{16}$	$37\frac{3}{16}$	50	$28\frac{1}{4}$	$24\frac{1}{8}$	$26\frac{11}{16}$	$33\frac{1}{16}$	32	$42\frac{1}{4}$	$60\frac{1}{2}$	55	$43\frac{1}{16}$
December	$41\frac{7}{16}$	$35\frac{3}{8}$	$46\frac{1}{8}$	$25\frac{7}{8}$	$23\frac{1}{8}$	$26\frac{1}{4}$	$35\frac{9}{16}$	$30\frac{3}{4}$	$37\frac{7}{8}$	65	$50\frac{1}{2}$	$42\frac{3}{8}$
Yearly average	$46\frac{1}{16}$	$39\frac{11}{16}$	$43\frac{1}{16}$	$40\frac{1}{8}$	$25\frac{5}{6}$	$25\frac{9}{16}$	$31\frac{5}{8}$	$33\frac{7}{16}$	$38\frac{1}{4}$	$50\frac{1}{12}$	$59\frac{15}{16}$	$46\frac{1}{8}$

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

WHEAT.

Wheat crop of countries named, 1899–1903.

Country.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	547,304,000	522,230,000	748,460,000	670,063,000	637,822,000
Ontario	22,158,000	31,265,000	22,118,000	26,904,000	22,584,000
Manitoba	28,802,000	13,436,000	52,094,000	54,750,000	41,381,000
Rest of Canada	9,000,000	7,000,000	16,000,000	17,000,000	19,000,000
Total Canada	59,960,000	51,701,000	90,212,000	98,654,000	82,965,000
Mexico	9,287,000	12,429,000	12,021,000	8,447,000	12,000,000
Total North America	616,551,000	586,360,000	850,693,000	777,164,000	732,787,000
Chile	13,000,000	12,000,000	9,000,000	12,000,000	13,000,000
Argentina	104,982,000	101,655,000	74,753,000	56,380,000	100,636,000
Uruguay	7,164,000	6,891,000	3,664,000	7,604,000	5,240,000
Total South America	125,146,000	120,546,000	87,417,000	75,984,000	118,876,000
Great Britain	67,594,000	54,299,000	54,111,000	58,463,000	49,144,000
Ireland	1,786,000	1,682,000	1,470,000	1,602,000	1,176,000
Total United Kingdom	69,380,000	55,981,000	55,581,000	60,065,000	50,320,000
Norway	260,000	300,000	300,000	260,000	260,000
Sweden	4,430,000	5,249,000	4,310,000	4,649,000	5,547,000
Denmark	3,654,000	3,604,000	942,000	4,528,000	4,000,000
Netherlands	5,096,000	4,670,000	4,300,000	5,089,000	4,500,000
Belgium	11,319,000	13,788,000	14,143,000	14,521,000	13,905,000
France	364,414,000	326,083,000	310,938,000	327,841,000	365,601,000
Spain	100,759,000	92,424,000	117,765,000	114,927,000	102,157,000
Portugal	6,400,000	8,000,000	10,000,000	10,400,000	8,000,000
Italy	137,912,000	133,741,000	164,587,000	136,210,000	184,450,000
Switzerland	4,200,000	4,200,000	4,400,000	4,200,000	4,000,000
Germany	141,369,000	141,139,000	91,817,000	143,315,000	130,626,000
Austria	50,209,000	40,929,000	44,027,000	49,655,000	46,014,000
Hungary	141,285,000	141,202,000	123,936,000	170,884,000	161,956,000
Croatia-Slavonia	9,014,000	11,035,000	10,693,000	12,017,000	13,699,000
Bosnia-Herzegovina	2,000,000	1,750,000	2,000,000	2,300,000	3,923,000
Total Austria-Hungary	202,508,000	194,916,000	180,656,000	234,856,000	225,592,000
Roumania	26,064,000	56,663,000	72,386,000	76,220,000	73,700,000
Bulgaria	21,630,000	27,000,000	24,000,000	34,642,000	36,744,000
Servia	10,000,000	8,135,000	9,000,000	11,409,000	13,411,000
Montenegro	200,000	220,000	200,000	200,000	200,000
Turkey in Europe	15,000,000	20,000,000	22,000,000	25,000,000	26,000,000
Greece	2,500,000	3,000,000	3,200,000	3,200,000	6,000,000
Russia proper	314,876,000	319,193,000	319,991,000	463,258,000	454,596,000
Poland	21,544,000	19,722,000	14,409,000	20,349,000	19,255,000
North Caucasus	57,313,000	56,948,000	67,232,000	77,069,000	77,941,000
Finland	143,000	159,000	140,000	150,000	150,000
Total Russia in Europe	393,876,000	396,022,000	401,772,000	560,826,000	551,942,000
Total Europe	1,520,971,000	1,495,135,000	1,492,297,000	1,772,358,000	1,806,955,000

Wheat crop of countries named, 1899-1903—Continued.

Country.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Siberia	45,473,000	20,172,000	16,504,000	30,796,000	69,665,000
Central Asia	14,938,000	6,959,000	9,645,000	15,897,000	
Transcaucasia	33,000,000	35,000,000	35,000,000	35,000,000	35,000,000
Total Russia in Asia	93,411,000	62,131,000	61,149,000	81,693,000	104,665,000
Turkey in Asia	35,200,000	30,000,000	30,000,000	35,000,000	33,000,000
Cyprus	2,000,000	2,400,000	2,000,000	1,800,000	2,000,000
Persia	16,000,000	16,000,000	15,200,000	13,600,000	16,000,000
British India	255,260,000	200,000,000	268,110,000	227,380,000	294,725,000
Japan	20,771,000	21,688,000	22,457,000	20,000,000	21,000,000
Total Asia	422,642,000	332,219,000	398,916,000	379,473,000	471,390,000
Algeria	22,282,000	23,000,000	23,000,000	33,804,000	25,000,000
Tunis	4,800,000	5,600,000	6,400,000	7,000,000	7,400,000
Egypt	13,000,000	13,000,000	12,000,000	12,000,000	11,000,000
Cape Colony	2,291,000	2,000,000	2,000,000	2,000,000	2,000,000
Total Africa	42,373,000	43,600,000	43,400,000	54,804,000	45,400,000
West Australia	892,000	1,018,000	799,000	963,000	1,001,000
South Australia	9,056,000	8,720,000	11,608,000	8,265,000	6,555,000
Queensland	626,000	634,000	1,232,000	1,746,000	6,000
New South Wales	9,569,000	14,033,000	16,683,000	15,275,000	1,635,000
Victoria	20,198,000	15,718,000	18,410,000	12,510,000	2,650,000
Tasmania	2,376,000	1,136,000	1,145,000	994,000	905,000
New Zealand	13,485,000	8,852,000	6,733,000	4,174,000	7,693,000
Total Australasia	56,202,000	50,111,000	56,610,000	43,927,000	20,445,000

RECAPITULATION BY CONTINENTS.

North America	616,551,000	586,360,000	850,693,000	777,164,000	732,787,000
South America	125,146,000	120,546,000	87,417,000	75,984,000	118,876,000
Europe	1,520,971,000	1,495,135,000	1,492,297,000	1,772,358,000	1,806,955,000
Asia	422,642,000	332,219,000	398,916,000	379,473,000	471,390,000
Africa	42,373,000	43,600,000	43,400,000	54,804,000	45,400,000
Australasia	56,202,000	50,111,000	56,610,000	43,927,000	20,445,000
Total	2,783,885,000	2,627,971,000	2,929,333,000	3,103,710,000	3,195,853,000

World's visible supply of wheat, first of each month, for ten years.[a]

Month.	1894-1895.	1895-1896.	1896-1897.	1897-1898.	1898-1899.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	172,665,000	160,303,000	137,454,000	88,378,000	86,773,000
August	174,750,000	158,042,000	124,292,000	77,590,000	70,101,000
September	189,545,000	152,276,000	126,485,000	87,075,000	66,511,000
October	205,200,000	176,584,000	151,271,000	119,162,000	83,090,000
November	220,887,000	209,859,000	190,559,000	139,321,000	106,886,000
December	218,847,000	218,796,000	202,329,000	156,016,000	135,846,000
January	227,885,000	224,778,000	184,616,000	157,008,000	147,197,000
February	223,095,000	202,832,000	173,496,000	151,717,000	146,458,000
March	212,444,000	191,905,000	155,533,000	140,571,000	151,124,000
April	198,257,000	180,627,000	139,049,000	132,037,000	141,950,000
May	186,518,000	161,149,000	121,491,000	111,233,000	139,521,000
June	171,187,000	147,564,000	106,912,000	109,845,000	136,952,000

Month.	1899-1900.	1900-1901.	1901-1902.	1902-1903.	1903-1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	140,299,000	149,839,000	135,692,000	103,671,000	95,820,000
August	134,525,000	150,193,000	132,379,000	93,944,000	87,566,000
September	142,595,000	164,629,000	141,071,000	102,364,000	96,907,000
October	162,877,000	188,200,000	159,465,000	133,376,000	132,972,000
November	191,189,000	200,892,000	169,854,000	163,491,000	150,658,000
December	203,477,000	203,237,000	202,108,000	179,483,000	161,891,000
January	200,388,000	200,534,000	200,990,000	174,640,000	167,712,000
February	190,535,000	197,851,000	202,278,000	168,170,000	159,464,000
March	181,527,000	192,749,000	191,877,000	163,658,000	152,035,000
April	184,141,000	187,817,000	179,789,000	149,748,000	147,859,000
May	175,776,000	171,753,000	155,486,000	127,088,000	....
June	159,405,000	152,518,000	131,255,000	112,963,000	....

[a] From Broomhall's Corn Trade News.

World's export of wheat and flour for five years, 1899–1903.[a]

[Crop years ending August 1.]

Country.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States and Canada	224,784,000	186,248,000	246,168,000	261,248,000	237,472,000
Russia	68,208,000	54,984,000	75,744,000	87,448,000	134,176,000
Balkan Peninsula	27,152,000	16,384,000	40,152,000	44,152,000	57,008,000
Argentina and Uruguay	42,392,000	80,352,000	38,456,000	21,144,000	[b] 61,144,000
India	26,408,000	2,636,000	5,056,000	15,600,000	27,192,000
Australia and New Zealand	9,120,000	7,108,000	18,432,000	14,792,000	....
Total	398,064,000	347,712,000	424,008,000	444,384,000	....

[a] From Broomhall's Corn Trade News.
[b] Non-European quantities included this season.

Visible supply of wheat in the United States and Canada, first of each month, for ten years.

EAST OF ROCKY MOUNTAINS.[a]

Month.	1894–1895.	1895–1896.	1896–1897.	1897–1898.	1898–1899.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	65,250,000	53,568,000	61,354,000	27,090,000	18,069,000
August	69,766,000	46,767,000	58,414,000	23,793,000	12,325,000
September	79,826,000	44,732,000	57,588,000	20,073,000	11,499,000
October	92,100,000	55,078,000	63,955,000	31,508,000	22,857,000
November	108,072,000	75,598,000	76,716,000	42,609,000	31,864,000
December	113,116,000	87,688,000	76,433,000	50,059,000	45,914,000
January	113,707,000	97,769,000	73,270,000	54,173,000	50,126,000
February	106,917,000	97,592,000	68,092,000	51,105,000	51,648,000
March	98,745,000	94,538,000	61,624,000	46,532,000	51,085,000
April	91,286,000	90,442,000	55,946,000	40,901,000	51,238,000
May	80,454,000	80,390,000	49,684,000	31,039,000	47,258,000
June	64,375,000	68,773,000	37,975,000	29,226,000	42,092,000

Month.	1899–1900.	1900–1901.	1901–1902.	1902–1903.	1903–1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	46,870,000	58,523,000	39,317,000	27,453,000	24,142,000
August	48,622,000	60,398,000	40,924,000	31,436,000	21,480,000
September	48,087,000	66,240,000	39,348,000	32,366,000	21,558,000
October	60,040,000	76,071,000	51,442,000	40,454,000	33,043,000
November	77,195,000	82,238,000	64,616,000	63,480,000	43,463,000
December	84,687,000	86,591,000	85,631,000	77,288,000	56,857,000
January	89,265,000	87,911,000	94,909,000	80,769,000	61,827,000
February	87,473,000	86,324,000	88,800,000	81,748,000	62,013,000
March	85,570,000	80,704,000	84,315,000	78,083,000	56,688,000
April	79,690,000	75,501,000	75,598,000	70,141,000	49,639,000
May	70,764,000	60,298,000	54,610,000	52,585,000	....
June	57,617,000	47,109,000	37,676,000	36,040,000	....

[a] The figures for stocks east of the Rocky Mountains represent 62 principal points of accumulation, including the Manitoba elevators and stocks afloat on lakes and canals, as reported by Bradstreet's.

PACIFIC COAST.

Month.	1894–1895.	1895–1896.	1896–1897.	1897–1898.	1898–1899.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	8,253,000	6,549,000	1,927,000	1,112,000	2,935,000
August	8,321,000	4,762,000	1,917,000	2,247,000	2,608,000
September	8,532,000	8,799,000	3,512,000	4,651,000	3,005,000
October	9,074,000	9,760,000	5,454,000	6,251,000	4,671,000
November	13,130,000	9,651,000	6,883,000	7,391,000	5,621,000
December	14,582,000	8,276,000	6,548,000	6,944,000	6,296,000
January	13,302,000	7,116,000	4,189,000	6,661,000	5,923,000
February	13,118,000	5,859,000	3,005,000	5,318,000	5,039,000
March	11,801,000	4,296,000	1,857,000	4,424,000	5,101,000
April	10,456,000	3,822,000	1,730,000	3,466,000	4,321,000
May	10,150,000	3,182,000	1,614,000	3,051,000	4,455,000
June	8,445,000	2,556,000	1,221,000	3,236,000	3,635,000

Visible supply of wheat in the United States and Canada, first of each month for ten years—Continued.

PACIFIC COAST.

Month.	1899–1900.	1900–1901.	1901–1902.	1902–1903.	1903–1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	3,409,000	5,903,000	3,228,000	2,676,000	1,775,000
August	4,188,000	5,770,000	3,935,000	2,345,000	1,400,000
September	6,282,000	7,483,000	4,266,000	3,024,000	1,754,000
October	8,858,000	10,208,000	6,325,000	4,787,000	3,227,000
November	11,085,000	9,983,000	7,262,000	4,719,000	3,447,000
December	10,678,000	10,057,000	7,378,000	5,361,000	3,591,000
January	10,022,000	8,686,000	7,186,000	4,992,000	3,282,000
February	8,923,000	8,717,000	6,521,000	4,373,000	2,689,000
March	7,814,000	6,972,000	5,542,000	3,435,000	2,930,000
April	7,207,000	6,325,000	5,428,000	3,810,000	2,472,000
May	7,050,000	5,071,000	3,685,000	3,683,000	....
June	6,866,000	4,672,000	3,139,000	2,546,000	....

Statement showing the amount of wheat in farmers' hands, visible supply of the United States and Canada, and of the world, and price, on March 1, 1891–1904.

Year.	Stocks in farmers' hands in United States.	Visible supply of the United States and Canada.	Visible supply of the world.	Price at Chicago.
	Bushels.	*Bushels.*	*Bushels.*	*Cts. per bu.*
1891	112,470,655	50,995,000	....	94¼
1892	171,070,881	67,821,000	181,400,000	87⅜
1893	135,205,430	114,670,000	229,300,000	72⅝
1894	114,059,560	103,548,000	222,400,000	58⅜
1895	74,999,790	110,546,000	212,400,000	52¼
1896	123,045,290	98,834,000	191,900,000	66½
1897	88,149,072	63,481,000	155,500,000	74½
1898	121,320,500	50,956,000	140,600,000	104½
1899	198,056,496	56,189,000	151,100,000	72⅞
1900	158,745,595	93,384,000	181,500,000	64⅛
1901	128,098,074	87,676,000	192,700,000	74
1902	173,702,583	89,857,000	191,900,000	76
1903	164,047,106	81,518,000	163,700,000	74½
1904	132,608,382	59,618,000	152,000,000	77

Condition of wheat crop in the United States, monthly, 1886–1903.

Year.	Winter wheat.					Spring wheat.			
	April.	May.	June.	July.	When harvested.	June.	July.	August.	When harvested.
1886	94.1	94.9	92.7	91.2	90.8	98.5	83.3	80.1	83.5
1887	88.1	85.8	84.9	83.5	84.0	87.3	79.3	78.8	78.1
1888	82.0	73.1	73.3	75.6	77.4	92.8	95.9	87.3	77.2
1889	94.0	96.0	93.1	92.0	89.4	94.4	83.3	81.2	83.8
1890	81.0	80.0	78.1	76.2	73.5	91.3	94.4	83.2	79.8
1891	96.9	97.9	96.6	96.2	96.7	92.6	94.1	95.5	97.2
1892	81.2	84.0	88.3	89.6	87.6	92.3	90.9	87.3	81.2
1893	77.4	75.3	75.5	77.7	*a*74.0	86.4	74.1	67.0	....
1894	86.7	81.4	83.2	83.9	*a*83.7	88.0	68.4	67.1	....
1895	81.4	82.9	71.1	65.8	*a*75.4	97.8	102.2	95.9	....
1896	77.1	82.7	77.9	75.6	*a*74.6	99.9	93.3	78.9	....
1897	81.4	80.2	78.5	81.2	*a*85.7	89.6	91.2	86.7	....
1898	86.7	86.5	90.8	85.7	*a*86.7	100.9	95.0	96.5	....
1899	77.9	76.2	67.3	65.6	*a*70.9	91.4	91.7	83.6	....
1900	82.1	88.9	82.7	80.8	*a*69.6	87.3	55.2	56.4	....
1901	91.7	94.1	87.8	88.3	*a*82.8	92.0	95.6	80.3	....
1902	78.7	76.4	76.1	77.0	*a*80.0	95.4	92.4	89.7	....
1903	97.3	92.6	82.2	78.8	*a*74.7	95.9	82 5	77.1	....

a Includes both winter and spring.

Acreage, production, value, prices, and exports of wheat of the United States, 1866–1903.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including flour, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1866	15,424,496	9.9	151,999,906	152.7	232,109,630	129	145	185	211	12,646,941
1867	18,321,561	11.6	212,441,400	145.2	308,387,146	126	140	134	161	25,284,803
1868	18,460,132	12.1	224,036,600	108.5	243,032,746	80	88	87	96	29,717,201
1869	19,181,004	13.6	260,146,900	76.5	199,024,996	63	76	79	92	53,900,780
1870	18,992,591	12.4	235,884,700	94.4	222,766,969	91	98	113	120	52,580,111
1871	19,943,893	11.6	230,722,400	114.5	264,075,851	107	111	120	143	38,995,755
1872	20,858,359	11.9	249,997,100	111.4	278,522,068	97	108	112	122	52,014,715
1873	22,171,676	12.7	281,254,700	106.9	300,669,533	96	106	105	114	91,510,398
1874	24,967,027	12.3	308,102,700	86.3	265,881,167	78	83	78	94	72,912,817
1875	26,381,512	11.1	292,136,000	89.5	261,396,926	82	91	89	100	74,750,682
1876	27,627,021	10.5	289,356,500	96.3	278,697,238	104	117	130	172	57,043,936
1877	26,277,546	13.9	364,194,146	105.7	385,089,444	103	108	98	113	92,071,726
1878	32,108,560	13.1	420,122,400	77.6	325,814,119	81	84	91	102	150,502,506
1879	32,545,950	13.8	448,756,630	110.8	497,030,142	122	133½	112½	119	180,304,180
1880	37,986,717	13.1	498,549,868	95.1	474,201,850	93½	109¾	101	112⅝	186,321,514
1881	37,709,020	10.2	383,280,090	119.2	456,880,427	124¾	129	123	140	121,892,389
1882	37,067,194	13.6	504,185,470	88.4	445,602,125	91⅛	94¾	108	113⅜	147,811,316
1883	36,455,593	11.6	421,086,160	91.1	383,649,272	94⅝	99¼	85	94¾	111,534,182
1884	39,475,885	13.0	512,765,000	64.5	330,862,260	69½	76⅜	85⅜	90¾	132,570,366
1885	34,189,246	10.4	357,112,000	77.1	275,320,390	82⅞	89	72⅛	79	94,565,793
1886	36,806,184	12.4	457,218,000	68.7	314,226,020	75⅛	79½	80¾	88¾	153,804,969
1887	37,641,783	12.1	456,329,000	68.1	310,612,960	75⅛	79¼	81¼	89⅞	119,625,344
1888	37,336,138	11.1	415,868,000	92.6	385,248,030	96⅝	105½	77¼	95½	88,600,742
1889	38,123,859	12.9	490,560,000	69.8	342,491,707	76¾	80½	89¾	100	109,430,467
1890	36,087,154	11.1	399,262,000	83.8	334,773,678	87½	92¾	98⅞	108	106,181,316
1891	39,916,897	15.3	611,780,000	83.9	513,472,711	89⅜	93¼	80	85¾	225,665,812
1892	38,554,430	13.4	515,949,000	62.4	322,111,881	69½	73	68¼	76¼	191,912,635
1893	34,629,418	11.4	396,131,725	53.8	213,171,381	59⅛	64½	52⅛	60½	164,283,129
1894	34,882,436	13.2	460,267,416	49.1	225,902,025	52¾	63⅝	60¾	85⅜	144,812,718
1895	34,047,332	13.7	467,102,947	50.9	237,938,998	53¾	64¾	57⅛	67⅝	126,443,968
1896	34,618,646	12.4	427,684,346	72.6	310,602,539	74⅝	93⅛	68¾	97⅞	145,124,972
1897	39,465,066	13.4	530,149,168	80.8	428,547,121	92	109	117	185	217,306,005
1898	44,055,278	15.3	675,148,705	58.2	392,770,320	62¾	70	68⅜	79½	222,618,420
1899	44,592,516	12.3	547,303,846	58.4	319,545,259	64	69½	63⅝	67½	186,096,762
1900	42,495,385	12.3	522,229,505	61.9	323,515,177	69¼	75⅝	70	75⅛	215,990,073
1901	49,895,514	15.0	748,460,218	62.4	467,350,156	73	79½	72⅜	76¼	234,772,516
1902	46,202,424	14.5	670,063,008	63.0	422,224,117	71⅞	77¾	74¾	80⅝	202,906,273
1903	49,464,967	12.9	637,821,835	69.5	443,024,826	77¾	87	......	......	....

Acreage, production, value, and distribution of wheat of the United States in 1903, by States.

States and Territories.	Crop of 1903. Acreage.	Production.	Value.	Stock in farmers' hands Mar. 1, 1904.		Shipped out of county where grown.
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	8,132	207,366	203,219	51,842	25	....
Vermont	1,708	35,697	33,912	11,423	32	....
New York	544,039	9,683,894	7,843,954	2,711,490	28	1,936,779
New Jersey	113,456	1,588,384	1,302,475	349,444	22	190,606
Pennsylvania	1,669,131	26,038,444	20,570,371	7,290,764	28	5,207,689
Delaware	114,489	1,167,788	910,875	210,202	18	478,793
Maryland	809,667	10,120,838	7,995,462	1,821,751	18	6,274,920
Virginia	804,557	6,999,646	5,879,703	1,469,926	21	2,729,862
North Carolina	633,060	3,228,606	3,131,748	613,435	19	96,858
South Carolina	270,261	1,756,696	1,774,263	193,237	11	35,134
Georgia	299,958	1,859,740	1,785,350	334,753	18	92,987
Alabama	112,133	1,020,410	969,390	193,878	19	40,816
Mississippi	3,569	28,552	26,553	6,281	22	....
Texas	1,483,595	19,880,173	15,506,535	3,379,629	17	7,156,862
Arkansas	274,654	1,922,578	1,499,611	384,516	20	153,806
Tennessee	1,083,531	7,693,070	6,462,179	1,307,822	17	2,000,198
West Virginia	404,785	4,128,807	3,509,486	1,114,778	27	412,881
Kentucky	920,028	7,728,235	6,259,870	1,391,082	18	1,854,776
Ohio	2,065,950	28,303,515	22,642,812	6,509,808	23	12,453,547
Michigan	1,001,604	15,524,862	11,954,144	3,725,967	24	5,899,448
Indiana	2,399,403	23,994,030	18,715,343	4,798,806	20	12,236,955
Illinois	1,972,850	16,571,940	12,428,955	3,148,669	19	7,457,373
Wisconsin	536,589	8,365,335	6,023,041	2,425,947	29	1,589,414
Minnesota	5,393,328	70,652,597	48,750,292	17,663,149	25	48,043,766
Iowa	1,010,472	12,531,304	7,769,409	3,258,139	26	3,258,139

Acreage, production, value, and distribution of wheat of the United States in 1903, by States—Continued.

States and Territories.	Crop of 1903.			Stock on hand Mar. 1, 1904.		Shipped out of county where grown.
	Acreage.	Production.	Value.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Missouri	2,551,105	22,194,614	15,758,176	3,551,138	16	10,209,522
Kansas	6,181,176	87,249,557	51,477,239	15,704,920	18	65,437,168
Nebraska	2,687,324	42,157,560	22,765,082	10,539,390	25	27,823,990
South Dakota	3,424,130	47,252,994	29,296,856	11,813,248	25	37,329,865
North Dakota	4,349,652	55,240,580	34,801,565	9,390,899	17	45,297,276
Montana	98,735	2,784,327	1,837,656	863,141	31	361,963
Wyoming	22,667	473,740	350,568	116,859	31	9,475
Colorado	279,082	7,423,581	4,899,563	1,410,480	19	3,860,262
New Mexico	44,712	822,701	617,026	172,767	21	16,454
Arizona	19,129	483,964	450,087	91,953	19	....
Utah	183,897	4,156,072	3,324,858	1,579,307	38	1,163,700
Nevada	21,426	591,358	585,444	41,395	7	....
Idaho	242,550	5,127,987	3,845,990	1,076 877	21	2,974,232
Washington	982,241	19,986,345	13,790,579	3,397,679	17	14,590,032
Oregon	684,961	12,438,827	9,577,896	2,114,601	17	6,468,190
California	1,868,410	20,926,192	18,205,787	2,929,667	14	14,857,596
Oklahoma	1,613,130	24,482,637	15,421,061	2,937,916	12	19,341,283
Indian Territory	249,691	2,996,292	2,067,441	479,407	16	239,703
United States	49,464,967	637,821,835	443,024,826	132,608,382	20.8	369,582,320

Acreage, production, and farm value, winter and spring wheat of United States in 1903.

States and Territories.	Winter wheat.					Spring wheat.				
	Acreage.	Yield.	Production.	Price.	Total value.	Acreage.	Yield.	Production.	Price.	Total value.
	Acres.	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*	*Acres.*	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*
Maine	....	....	....	....	....	8,132	25.5	207,366	98	203,219
Vermont	....	....	....	....	....	1,708	20.9	35,697	95	33,912
New York	514,039	17.8	9,683,894	81	7,843,954	....	....	....	....	....
New Jersey	113,456	14.0	1,588,384	82	1,302,475	....	....	....	....	....
Pennsylvania	1,669,131	15.6	26,038,444	79	20,570,371	....	....	....	....	....
Delaware	114,489	10.2	1,167,788	78	910,875	....	....	....	....	....
Maryland	809,667	12.5	10,120,838	79	7,995,462	....	....	....	....	....
Virginia	804,557	8.7	6,999,646	84	5,879,703	....	....	....	....	....
North Carolina	633,060	5.1	3,228,606	97	3,131,748	....	....	....	....	....
South Carolina	270,261	6.5	1,756,696	101	1,774,263	....	....	....	....	....
Georgia	299,958	6.2	1,859,740	96	1,785,350	....	....	....	....	....
Alabama	112,133	9.1	1,020,410	95	969,390	....	....	....	....	....
Mississippi	3,569	8.0	28,552	93	26,553	....	....	....	....	....
Texas	1,483,595	13.4	19,880,173	78	15,506,535	....	....	....	....	....
Arkansas	274,654	7.0	1,922,578	78	1,499,611	....	....	....	....	....
Tennessee	1,083,531	7.1	7,693,070	84	6,462,179	....	....	....	....	....
West Virginia	404,785	10.2	4,128,807	85	3,509,486	....	....	....	....	....
Kentucky	920,028	8.4	7,728,235	81	6,259,870	....	....	....	....	....
Ohio	2,065,950	13.7	28,303,515	80	22,642,812	....	....	....	....	....
Michigan	1,001,604	15.5	15,524,862	77	11,954,144	....	....	....	....	....
Indiana	2,399,403	10.0	23,991,030	78	18,715,343	....	....	....	....	....
Illinois	1,972,850	8.4	16,571,940	75	12,428,955	....	....	....	....	....
Wisconsin	132,784	18.6	2,469,782	72	1,778,243	403,805	14.6	5,895,553	72	4,244,798
Minnesota	....	....	....	....	....	5,393,328	13.1	70,652,597	69	48,750,292
Iowa	80,156	15.9	1,274,480	62	790,178	930,316	12.1	11,256,824	62	6,979,231
Missouri	2,551,105	8.7	22,194,614	71	15,758,176	....	....	....	....	....
Kansas	5,951,146	14.0	83,316,044	59	49,156,466	230,030	17.1	3,933,513	59	2,320,773
Nebraska	2,183,494	16.4	35,809,302	54	19,337,023	503,830	12.6	6,348,258	54	3,428,059
South Dakota	....	....	....	....	....	3,424,130	13.8	47,252,994	62	29,296,856
North Dakota	....	....	....	....	....	4,349,652	12.7	55,240,580	63	34,801,565
Montana	....	....	....	....	....	98,735	28.2	2,784,327	66	1,837,656
Wyoming	....	....	....	....	....	22,667	20.9	473,740	74	350,568
Colorado	....	....	....	....	....	279,082	26.6	7,423,581	66	4,899,563
New Mexico	....	....	....	....	....	44,712	18.4	822,701	75	617,026
Arizona	....	....	....	....	....	19,129	25.3	483,964	93	450,087
Utah	....	....	....	....	....	183,897	22.6	4,156,072	80	3,324,858
Nevada	....	....	....	....	....	21,426	27.6	591,358	99	585,444
Idaho	127,759	21.0	2,682,939	75	2,012,204	114,791	21.3	2,445,048	75	1,833,786
Washington	373,989	20.1	7,517,179	69	5,186,854	608,252	20.5	12,469,166	69	8,603,725
Oregon	368,126	18.9	6,957,581	77	5,357,337	316,835	17.3	5,481,246	77	4,220,559
California	1,868,410	11.2	20,926,192	87	18,205,787	....	....	....	....	....
Oklahoma	1,643,130	14.9	24,482,637	63	15,424,061	....	....	....	....	....
Indian Ter.	249,691	12.0	2,996,292	69	2,067,441	....	....	....	....	....
United States	32,510,510	12.3	399,867,250	71.6	286,242,849	16,954,457	11.0	237,951,585	65.9	156,781,977

Average yield per acre of wheat in the United States, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	21.1	19.2	22.0	16.5	19.5	22.5	19.5	23.9	25.3	25.5
New Hampshire	20.0	19.3	21.0	16.0	19.0	17.2	16.3	......	......	......
Vermont	22.7	29.0	24.5	17.0	22.5	22.0	23.5	18.7	18.8	20.9
Connecticut	......	......	......	20.0	20.0	18.3	20.8	......	......	......
New York	14.8	18.1	16.0	21.4	21.2	18.5	17.7	13.1	16.8	17.8
New Jersey	15.3	12.4	15.3	18.5	17.4	14.5	19.1	16.8	16.0	14.0
Pennsylvania	15.0	16.6	14.0	19.7	17.5	13.6	13.5	17.1	15.8	15.6
Delaware	13.0	11.6	18.0	21.5	13.3	12.8	20.3	18.5	16.5	10.2
Maryland	15.3	17.0	17.0	19.2	15.3	14.1	19.5	17.2	14.7	12.5
Virginia	9.5	9.3	9.3	12.0	14.1	8.4	11.9	10.9	5.7	8.7
North Carolina	5.0	6.9	7.3	8.0	9.2	6.7	9.6	8.7	5.3	5.1
South Carolina	5.6	6.4	6.8	8.7	10.6	6.5	9.0	8.8	5.6	6.5
Georgia	6.9	6.2	8.0	9.4	10.0	6.8	9.1	8.2	6.0	6.2
Alabama	8.3	7.5	8.0	10.0	12.0	7.6	9.5	8.7	6.0	9.1
Mississippi	9.8	8.0	8.5	10.0	13.9	7.7	9.6	8.8	8.0	8.0
Texas	15.1	5.7	11.7	15.8	14.8	11.1	18.4	8.9	9.0	13.4
Arkansas	8.8	9.4	8.0	10.5	11.0	8.6	10.1	8.8	9.1	7.0
Tennessee	8.1	8.8	8.5	11.2	13.2	8.7	9.9	10.8	7.2	7.1
West Virginia	12.1	10.6	10.3	13.4	13.8	9.3	9.8	10.9	7.7	10.2
Kentucky	12.5	10.9	8.7	13.6	15.4	9.1	13.0	12.1	9.3	8.4
Ohio	19.0	13.3	9.0	16.9	16.9	14.2	6.0	15.3	17.1	13.7
Michigan	15.8	13.2	12.8	15.6	20.8	8.4	7.6	11.1	17.7	15.5
Indiana	18.4	9.2	9.0	13.0	15.6	9.8	5.3	15.8	16.0	10.0
Illinois	18.2	11.0	14.7	7.9	11.0	10.0	13.0	17.6	17.9	8.4
Wisconsin	16.5	15.5	13.3	12.5	18.0	15.5	15.5	16.1	18.1	15.6
Minnesota	13.5	23.0	14.2	13.0	15.8	13.4	10.5	12.9	13.9	13.1
Iowa	14.8	19.5	16.0	13.0	16.7	13.0	15.6	16.2	12.7	12.4
Missouri	15.3	12.0	11.7	9.0	9.8	9.9	12.5	15.9	19.9	8.7
Kansas	10.4	7.7	10.6	15.5	14.2	9.8	17.7	18.5	10.4	14.1
Nebraska	7.0	12.0	14.0	14.5	16.4	10.3	12.0	17.1	20.9	15.7
South Dakota	6.6	12.0	11.2	8.0	12.4	10.7	6.9	12.9	12.2	13.8
North Dakota	11.8	21.0	11.8	10.3	14.4	12.8	4.9	13.1	15.9	12.7
Montana	24.8	23.9	26.5	32.5	29.5	25.7	26.6	26.5	26.0	28.2
Wyoming	19.6	26.0	24.5	25.0	23.7	18.8	17.6	24.5	23.5	20.9
Colorado	17.9	23.5	17.5	24.0	26.3	23.7	22.6	24.1	18.0	26.6
New Mexico	18.0	20.4	21.0	24.0	23.8	13.8	21.0	21.5	17.1	18.4
Arizona	17.0	20.5	23.0	18.0	31.7	15.3	14.6	21.8	18.7	25.3
Utah	22.0	22.4	26.5	21.0	28.0	20.7	20.9	20.5	21.2	22.6
Nevada	20.0	21.7	30.0	24.3	29.0	18.0	24.5	25.1	27.1	27.6
Idaho	20.6	17.8	24.5	22.0	31.0	24.2	20.8	21.2	22.1	21.1
Washington	16.6	15.5	18.0	23.5	24.2	22.7	23.5	29.1	22.2	20.3
Oregon	17.7	20.0	17.0	17.0	20.5	19.2	13.8	21.1	20.0	18.2
California	11.3	13.0	14.6	10.0	9.1	14.1	10.3	13.0	10.9	11.2
Oklahoma	11.3	11.4	13.0	19.0	14.9	13.3	19.0	16.4	11.1	14.9
Indian Territory	......	......	......	......	......	......	......	12.2	12.3	12.0
General average	13.2	13.7	12.4	13.4	15.3	12.3	12.3	15.0	14.5	12.3

Average yield of wheat in certain countries, in bushels per acre, 1894–1902.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(a)	(b)	(b)	(b)	(b)	(a)	(a)
1894	13.2	10.8	25.1	17.4	18.2	20.1	31.7
1895	13.7	9.8	24.4	15.3	20.7	19.7	27.2
1896	12.4	9.0	26.4	15.9	19.4	20.0	34.7
1897	13.4	7.3	25.3	13.2	11.7	15.1	30.0
1898	15.3	9.8	27.2	18.0	17.1	21.1	35.8
1899	12.3	9.1	28.4	18.9	17.8	21.2	33.8
1900	12.3	8.1	27.9	15.5	16.9	19.2	29.5
1901	15.0	7.9	23.5	16.7	15.1	18.5	31.9
1902	14.5	11.0	30.3	19.0	20.6	20.2	33.9
Average	13.6	9.2	26.5	16.7	17.5	19.5	32.1

a Winchester bushels. b Bushels of 60 pounds.

Average value per acre of wheat in the United States, based upon farm value December 1, 1894-1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$16.67	$15.74	$18.48	$17.49	$17.36	$20.47	$17.55	$23.18	$23.28	$24.99
New Hampshire	16.00	14.67	21.00	17.60	17.48	16.34	15.00	......	......	......
Vermont	15.21	20.01	22.79	17.68	20.25	18.70	18.33	17.58	20.49	19.85
Connecticut	......	......	......	20.00	17.60	17.39	17.05	......	......	......
New York	9.18	12.31	14.08	19.26	15.26	14.80	13.63	10.74	13.27	14.42
New Jersey	9.33	8.80	13.62	17.20	12.70	10.88	14.13	12.10	12.16	11.48
Pennsylvania	8.40	10.79	11.62	17.93	11.90	8.98	9.72	12.31	11.53	12.32
Delaware	7.15	7.42	15.66	20.21	9.18	8.70	14.21	13.13	12.38	7.96
Maryland	8.26	10.88	14.96	17.86	10.71	9.59	13.84	12.21	10.58	9.88
Virginia	5.32	6.05	7.44	11.04	9.31	5.80	8.57	7.96	4.50	7.31
North Carolina	3.25	4.97	6.06	7.52	7.18	5.49	7.87	7.13	4.88	4.95
South Carolina	4.87	5.63	6.05	10.27	9.96	6.44	9.09	8.62	5.71	6.56
Georgia	5.24	5.08	7.12	9.68	9.80	6.66	8.64	7.71	5.88	5.95
Alabama	6.47	6.00	6.80	10.10	10.80	6.76	8.45	7.66	5.58	8.65
Mississippi	7.35	4.88	6.97	9.90	11.54	6.01	8.06	7.57	6.80	7.44
Texas	8.15	3.76	8.78	14.06	10.06	7.55	11.78	6.94	6.93	10.45
Arkansas	4.84	5.55	5.68	8.82	6.38	5.50	6.57	6.86	6.10	5.46
Tennessee	4.13	5.46	6.29	10.64	8.84	6.79	7.82	7.99	5.47	5.96
West Virginia	7.26	7.31	8.03	11.93	9.80	6.60	7.55	8.39	6.31	8.67
Kentucky	6.25	6.65	6.61	12.10	9.55	6.01	8.97	8.71	6.88	6.80
Ohio	9.31	7.98	7.02	14.87	11.15	9.09	4.26	10.86	12.14	10.96
Michigan	8.22	7.92	10.75	13.57	13.31	5.46	5.24	7.88	12.21	11.94
Indiana	8.46	5.24	7.20	11.57	9.83	6.27	3.71	11.06	10.88	7.80
Illinois	8.19	5.83	10.88	7.03	6.60	6.30	8.32	12.14	10.56	6.30
Wisconsin	8.42	7.91	9.31	10.50	10.62	9.46	9.92	10.48	11.61	11.22
Minnesota	6.62	10.12	9.66	10.01	8.53	7.37	6.62	7.74	8.48	9.04
Iowa	7.40	8.97	9.92	9.75	8.68	7.15	9.20	9.75	6.96	7.69
Missouri	6.58	6.12	8.19	7.65	5.78	6.14	7.88	10.97	11.54	6.18
Kansas	4.58	3.47	6.68	11.47	7.10	5.10	9.73	10.92	5.73	8.33
Nebraska	3.43	4.80	8.12	10.00	7.71	5.05	6.36	9.23	10.23	8.47
South Dakota	3.04	4.56	6.94	5.52	6.20	5.35	4.00	6.84	6.95	8.56
North Dakota	5.07	7.98	7.55	7.62	7.34	6.53	2.84	7.07	9.22	8.00
Montana	13.39	17.45	17.49	22.10	17.11	15.68	16.23	17.76	16.12	18.61
Wyoming	12.35	16.64	15.19	17.50	16.35	12.60	13.38	16.91	19.04	15.47
Colorado	11.64	13.16	10.67	16.80	14.73	13.51	13.33	16.15	13.50	17.56
New Mexico	15.84	14.89	13.86	18.00	14.76	8.42	14.28	15.48	14.71	13.80
Arizona	17.00	13.33	18.40	13.32	29.16	9.79	11.53	18.53	19.64	23.53
Utah	11.66	9.86	18.02	14.28	15.12	10.97	11.49	14.35	16.11	18.08
Nevada	15.00	10.63	20.70	21.87	27.55	13.68	17.15	22.09	25.56	27.32
Idaho	9.48	8.37	15.93	15.40	15.81	12.10	9.57	12.93	15.44	15.86
Washington	6.47	6.35	13.32	15.98	13.07	11.58	11.99	13.67	14.44	14.04
Oregon	7.61	9.40	12.24	12.24	12.71	10.18	7.59	11.37	13.37	13.98
California	6.44	7.80	12.12	8.30	6.55	8.74	5.97	7.80	8.72	9.74
Oklahoma	5.76	5.47	8.84	14.44	7.75	7.05	10.07	10.33	6.44	9.39
Indian Territory	......	......	......	......	......	......	......	8.42	7.50	8.28
General average	6.48	6.99	8.97	10.86	8.92	7.17	7.61	9.37	9.14	8.96

LOSSES OF WHEAT WHEN OVERRIPE AND IN STORAGE.

Observations on wheat at the Michigan Experiment Station have included studies on the variation in weight during storage and on the relation of the degree of ripeness to the weight of the grain. As early as 1879, Dr. R. C. Kedzie showed that wheat when allowed to become overripe, or dead ripe, as it is generally called, weighs slightly less than when harvested at the period of complete ripeness. It was also found that the amount and quality of the flour, as well as the germinating power of the grain, are reduced when the crop is allowed to stand after complete ripeness has been reached. The greatest loss, however, due to overripeness is caused by the shelling of the grain. Certain varieties of wheat have a less tendency to shell than others, and by giving these the preference and harvesting at the proper stage of maturity, loss from this source can be reduced to a minimum. In 1898 the shrinkage of White Clawson, a soft, white wheat, and Buda-Pesth, a hard, red variety, was determined. At the time of thrashing the grain was dry and in good condition, and after having been stored for 322 days the White Clawson had lost less than a half of 1 per cent and the Buda-Pesth less than one-tenth of 1 per cent.

The loss of weight during storage was observed in an elevator in Michigan, where 1,500 bushels of wheat in a hard and dry condition were stored immediately after thrashing. After 10 days a shrinkage of a little over 30 bushels, or a loss of about 2 per cent, had occurred.

Average farm price of wheat per bushel in the United States December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$0.79	$0.82	$0.84	$1.06	$0.89	$0.91	$0.90	$0.97	$0.92	$0.98
New Hampshire	.80	.76	1.00	1.10	.92	.95	.92	......	......	......
Vermont	.67	.69	.93	1.04	.90	.85	.78	.94	1.09	.95
Connecticut	......	.68	......	1.00	.88	.95	.82	......	......	......
New York	.62	.68	.88	.90	.72	.80	.77	.82	.79	.81
New Jersey	.61	.71	.89	.93	.73	.75	.74	.72	.76	.82
Pennsylvania	.56	.65	.83	.91	.68	.66	.72	.72	.73	.79
Delaware	.55	.64	.87	.94	.69	.68	.70	.71	.75	.78
Maryland	.51	.64	.88	.93	.70	.68	.71	.71	.72	.79
Virginia	.56	.65	.80	.92	.66	.69	.72	.73	.79	.84
North Carolina	.65	.72	.83	.94	.78	.82	.82	.82	.92	.97
South Carolina	.87	.88	.89	1.18	.94	.99	1.01	.98	1.02	1.01
Georgia	.76	.82	.89	1.03	.98	.98	.95	.94	.98	.96
Alabama	.78	.80	.85	1.01	.90	.89	.89	.88	.93	.95
Mississippi	.75	.61	.82	.99	.83	.78	.84	.86	.85	.93
Texas	.54	.66	.75	.89	.68	.68	.64	.78	.77	.78
Arkansas	.55	.59	.71	.84	.58	.64	.65	.78	.67	.78
Tennessee	.51	.62	.74	.95	.67	.78	.79	.74	.76	.84
West Virginia	.60	.69	.78	.89	.71	.71	.77	.77	.82	.85
Kentucky	.50	.61	.76	.89	.62	.66	.69	.72	.74	.81
Ohio	.49	.60	.78	.88	.66	.64	.71	.71	.71	.80
Michigan	.52	.60	.84	.87	.64	.65	.69	.71	.69	.77
Indiana	.46	.57	.80	.89	.63	.64	.70	.70	.68	.78
Illinois	.45	.53	.74	.89	.60	.63	.64	.69	.59	.75
Wisconsin	.51	.51	.70	.84	.59	.61	.61	.65	.64	.72
Minnesota	.49	.44	.68	.77	.54	.55	.63	.60	.61	.69
Iowa	.50	.46	.62	.75	.52	.55	.59	.60	.55	.62
Missouri	.43	.51	.70	.85	.59	.62	.63	.69	.58	.71
Kansas	.44	.45	.63	.74	.50	.52	.55	.59	.55	.59
Nebraska	.49	.40	.58	.69	.47	.49	.53	.54	.49	.54
South Dakota	.46	.38	.62	.69	.50	.50	.58	.53	.57	.62
North Dakota	.43	.38	.64	.74	.51	.51	.58	.51	.58	.63
Montana	.54	.73	.66	.68	.58	.61	.61	.67	.62	.66
Wyoming	.63	.64	.62	.70	.69	.67	.76	.69	.81	.74
Colorado	.65	.56	.61	.70	.56	.57	.59	.67	.75	.66
New Mexico	.88	.73	.66	.75	.62	.61	.68	.72	.86	.75
Arizona	1.00	.65	.80	.74	.92	.64	.79	.85	1.05	.93
Utah	.53	.44	.68	.68	.54	.53	.55	.70	.76	.80
Nevada	.75	.49	.69	.90	.95	.76	.70	.88	.98	.99
Idaho	.46	.47	.65	.70	.51	.50	.46	.61	.70	.75
Washington	.39	.41	.74	.68	.54	.51	.51	.47	.65	.69
Oregon	.43	.47	.72	.72	.62	.53	.55	.54	.67	.77
California	.57	.60	.83	.83	.72	.62	.58	.60	.80	.87
Oklahoma	.51	.48	.68	.76	.52	.53	.53	.63	.58	.63
Indian Territory	......	......	......	......	......	......	......	.69	.61	.69
General average	.491	.509	.726	.808	.582	.584	.619	.624	.630	.695

Transportation rates, average for wheat, in cents, St. Louis to New Orleans, by river.

Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.
1877	8.11	20.04	1884	6.63	14.00	1891	6.88	16.28	1898	4.50	10.00
1878	7.19	17.36	1885	6.40	15.00	1892	6.50	16.87	1899	a4.50	10.00
1879	7.75	18.00	1886	6.50	16.00	1893	6.55	17.54	1900	a4.25	10.00
1880	8.25	19.00	1887	6.00	18.25	1894	5.89	17.14	1901	a4.25	10.00
1881	6.00	20.00	1888	6.50	15.00	1895	5.95	13.00	1902	a4.20	10.00
1882	6.42	20.00	1889	5.95	17.93	1896	5.00	14.54	1903	a5.00	10.00
1883	5.50	17.75	1890	6.58	15.66	1897	4.88	10.83			

a F. o. b. New Orleans.

Wholesale prices of wheat per bushel in leading cities of the United States, 1898–1903.

Date.	New York.		Baltimore.		Chicago.		Detroit.		St. Louis.		Minneapolis.		San Francisco.	
	No. 2, red winter.		Southern, No. 2, red.				No. 2, red.		No. 2, red winter.		No. 2, northern.		No. 1, California (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1898.														
January	$0.99¾	$1.10½	$0.90	$1.01½	$0.89½	$1.10	$0.90	$0.97¾	$0.92½	$1.00½	$0.87½	$0.96	$1.37½	$1.41¼
February	1.02¼	1.10¼	.93	1.04	.95	1.08	.93½	.99¼	.94¾	1.01	.92¾	1.00	1.41¼	1.42½
March	.99⅞	1.08⅞	.94	1.03	1.00	1.06¾	.94¼	.98½	.96	1.00	.94½	.99½	1.40	1.46¼
April	1.01	1.28	.95	1.15	1.01	1.23½	.94½	1.12½	.97	1.10	.95¼	1.16¾	1.48¾	1.80
May	1.16½	1.93½	1.10	1.46½	1.17	1.85	1.10	1.60	1.00	1.27	1.14½	1.55	1.60	1.77½
June	.82	1.21	.60	1.16½	.75	1.20	.82	1.12	.69	1.00½	.80	1.30	1.60	1.77½
July	.74½	.94	.62	.87	.65¾	.88	.66½	.90	.64½	.79	.80	.87½	1.22½	1.25
August	.73⅛	.81¾	.60	.81	.65½	.75	.67	.74	.64	.73	.70	.87	1.08¾	1.20
September	.68¾	.79⅞	.60	.73¼	.62¾	.68	.67	.70	.65	.70	.55	.63	1.10	1.18¾
October	.72	.80¼	.63	.77½	.62	.70¼	.65½	.74	.65¾	.72¾	.56	.67	1.15	1.22½
November	.74¾	.78¾	.65	.74	.64½	.69½	.69	.71¾	.67½	.71⅞	.60	.63	1.15	1.21¼
December	.73⅞	.81¼	.62	.77	.62¾	.70	.66¾	.72¼	.68½	.73	.60	.67	1.13¾	1.15
1899.														
January	.79¼	.87⅜	.76	.81½	.66½	.76	.70½	.76½	.71	.79½	.65½	.72¼	1.11¼	1.15
February	.81	.87⅝	.74½	.78	.69¾	.74½	.72¼	.74½	.72½	.76	.67⅜	.69¼	1.10	1.12½
March	.78⅝	.87½	.72	.78	.66	.74½	.69	.75	.69	.76	.64	.70¼	1.05	1.12½
April	.79⅜	.85¼	.75½	.79½	.70	.76½	.71½	.76¾	.73⅝	.80	.68	.72	1.05	1.07½
May	.80⅛	.87⅛	.73¼	.79½	.68⅜	.79½	.73¼	.80	.73¼	.81⅝	.67¼	.73	1.05	1.06¼
June	.80	.85⅛	.75	.79	.71¼	.79¼	.75¼	.80¼	.73¾	.78½	.70½	.73⅞	1.06¼	1.10
July	.75⅞	.81¾	.71	.75¾	.68⅝	.75⅜	.71¼	.78	.69⅝	.75	.65⅞	.71¾	1.05	1.08¾
August	.74⅝	.78¼	.71	.73¼	.69	.74½	.70	.74	.68⅛	.73¼	.66	.70¼	1.02½	1.06¼
September	.73¾	.77⅝	.70½	.74½	.69⅜	.75⅛	.70½	.73½	.68	.72	.64⅞	.67⅞	1.02½	1.05
October	.75	.78¾	.71	.75½	.68⅜	.74¾	.70½	.73⅜	.69½	.73	.64¾	.69½	1.05	1.08¾
November	.72¼	.75⅝	.68½	.72	.65	.71½	.67½	.70¾	.68½	.70½	.61¾	.64	.97½	1.05
December	.72⅛	.76	.70	.72	.64	.69½	.68	.72	.69½	.72	.60	.64	.96¼	.97½
1900.											No. 1, northern.			
January	.72⅞	.78⅜	.70	.73	.61½	.67⅛	.66¾	.72	.66¼	.72	.62	.66¼	.95	.98¾
February	.74¾	.79⅞	.73	.76	.63⅞	.67½	.70¾	.73¼	.69	.71¾	.63	.65⅞	.96¼	1.00
March	.74½	.81⅜	.71½	.75½	.61	.67	.70¼	.72½	.69	.72¼	.63⅛	.66	.95	.96¼
April	.78	.81¼	.71½	.76	.64¾	.67¾	.71	.72¾	.70	.72¾	.64½	.66⅛	.95	.96¼
May	.78	.82¾	.72	.73½	.63⅝	.67½	.71¾	.74	.70¼	.71¼	.64½	.66⅛	.90	.95
June	.80	.96⅞	.72	.90	.65⅞	.87½	.73¼	.91½	.68¾	.86½	.64⅞	.88⅞	.91¼	1.07½
July	.81	.90¼	.73	.81½	.74	.81½	.77½	.84½	.71⅞	.80⅛	.74¾	.82¼	1.05	1.07½
August	.78¼	.83⅝	.71	.76	.71¾	.76¼	.74	.78¾	.68¾	.73	.72¼	.76	1.02½	1.05
September	.79¼	.85	.71⅜	.77	.72½	.79⅜	.75¼	.80¾	.71	.77½	.73½	.81¼	1.03¾	1.05
October	.76⅞	.82⅞	.71¼	.77	.71⅜	.77⅜	.75	.79½	.69	.75½	.73⅞	.80¼	.95	1.01¼
November	.77½	.81¼	.71¾	.73¾	.69⅝	.74¼	.74¼	.77½	.69½	.72¾	.72¾	.76⅝	.97½	1.00
December	.77⅜	.83⅛	.71⅛	.75⅛	.69¼	.74⅝	.74⅛	.81	.69¾	.71¼	.71⅞	.75¼	.96¼	.97½

1901.														
January	.79⅛	.83⅛	.73¾	.78	.71⅜	.76⅜	.78	.82⅛	.72	.77	.73	.77½	.97½	1.01¼
February	.79¾	.81¼	.76	.78¾	.72⅛	.74¾	.78½	.80¼	.73½	.75¾	.73	.74⅜	.95	.98¾
March	.80⅛	.82¼	.77¾	.81	.73¼	.76¼	.78½	.80	.74	.75¾	.73	.74⅝	.95	1.02½
April	.78⅛	.84¾	.76½	.81½	.69½	.74⅞	.74	.78	.71	.76¼	.70¼	.74½	1.00	1.05
May	.81¾	.84⅝	.78¾	.80½	.70	.75⅛	.74½	.77¼	.73½	.76	.70⅛	.74¼	.97½	1.01¼
June	.75½	.85¼	.72	.79½	.65½	.77¼	.67¾	.77¼	.63¼	.75½	.62⅞	.74¾	.96¼	1.00
July	.72¾	.79¾	.69¼	.75½	.63⅛	.71¾	.66½	.74	.61¼	.70¾	.60½	.69¾	.95	1.00
August	.76	.80½	.72	.78	.66⅝	.77	.68¼	.76½	.66¼	.73⅞	.66	.71½	.97½	.98¾
September	.75⅜	.77⅜	.78½	.75½	.68⅛	.71	.70½	.73½	.70⅜	.72½	.66¾	.69⅛	.96¼	.97½
October	.74⅝	.80⅝	.70½	.75	.66¾	.71½	.70	.74	.70½	.73½	.66	.68⅞	.95	.98¾
November	.80⅛	.83½	.74¼	.78	.70	.73¾	.73	.79½	.72¼	.80	.68⅛	.71½	.98⅜	1.01¼
December	.84¾	.89⅞	.78½	.85¾	.73	.79½	.79	.90½	.81	.88½	.71¾	.77	1.01¼	1.06¼
1902.														
January	.85¾	.94¼	.81⅜	.87½	.74	.80½	.86	.93½	.86½	.92½	.73⅝	.79½	1.05	1.08¾
February	.85⅞	.93¼	.80	.85⅝	.72⅞	.76½	.84¼	.87½	.83¼	.89	.72¼	.75⅛	1.07½	1.12½
March	.82	.90⅜	.76	.85	.69¾	.76	.77½	.85¾	.76⅜	.86¾	.70½	.75⅛	1.10	1.12½
April	.82	.92½	.75	.85½	.70	.76¾	.77½	.87¼	.77¼	.83½	.70⅝	.77⅜	1.10	1.13¾
May	.88¼	.93¾	.81	.87½	.72⅜	.76¼	.80	.88	.76½	.84½	.74	.78	1.11¼	1.16¼
June	.87⅜	.93⅜	.76	.83	.71¼	.75¾	.79	.81½	.76	.80	.73⅛	.77½	1.11¼	1.13¾
July	.76⅞	.92¼	.70¾	.81¾	.71½	.79	.72	.82	.65½	.78	.76⅜	.80⅜	1.13¾	1.16¼
August	.74⅞	.78⅜	.66¼	.74¼	.68¼	.76	.68½	.73	.63	.68¼	.74¼	.79¾	1.12½	1.15
September	.73½	.77	.68	.72¾	.70	.95	.70¾	.74	.66	.68½	.66½	.71¼	1.12½	1.20
October	.73⅞	.79	.69	.75½	.67½	.75½	.72	.76¾	.67¾	.72	.68	.73⅞	1.18¾	1.35
November	.76	.79⅞	.71¼	.77½	.69⅛	.77⅜	.75½	.80¾	.69	.71	.71⅞	.74½	1.32½	1.45
December	.76⅛	.80⅛	.71¼	.77	.71⅞	.77¾	.77½	.83	.69	.74½	.72¼	.74⅝	1.37½	1.43¾
1903.														
January	.78¼	.84⅜	......	......	.70¾	.79¼	.77¾	.83½	......	......	.73⅛	.78⅛	......	......
February	.81⅝	.84	......	......	.73¾	.80½	.79	.81	......	......	.75⅞	.78	......	......
March	.78½	.83⅛	......	......	.70¼	.75⅞	.74¼	.79	.70	.75½	.74⅜	.77⅞	......	......
April	.79	.86⅛	......	......	.71⅝	.79	.75¼	.77¾	.69¾	.73⅝	.74⅞	.77⅜	......	......
May	.81¾	.89⅝	......	......	.74¾	.80⅝	.76	.79⅛	......	......	.76	.80⅛	......	......
June	.85	.87	......	......	.74¼	.85⅞	.77⅜	.82	......	......	.79½	.88⅛	......	......
July	.80¼	.89⅜	......	......	.75	.84	.76⅝	.80	......	......	.83¼	.89¼	......	......
August	.83¾	.89⅝	......	......	.77¼	.90¼	.78½	.84	.79¼	.85	.83⅜	1.00	......	......
September	.81¾	.89½	......	......	.79½	.93	.79	.84¼	.84	.88	.82	.91¾	......	......
October	.82⅛	.91⅝	......	......	.76¾	.88	.82¾	.87¼	.85	.89	.78¼	.86	......	......
November	.83¾	.92⅜	......	......	.75¾	.86¼	.84	.90	.85½	.90½	.77⅝	.82⅛	......	......
December	.89⅛	.99⅞	......	......	.77¾	.87	.89½	.94	.89½	.94	.80½	.83⅞	......	......

Monthly average prices of wheat in Chicago.[a]

[Cents per bushel.]

Month.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	87 1/4	75 1/16	61 7/16	55 1/8	62 5/16	82 5/8	99 9/16	71 1/4	64 5/16	73 7/8	77 1/4	75
February	87 15/16	73 15/16	57 1/2	53 7/8	66 5/8	79 5/8	101 1/2	72 1/8	65 11/16	73 7/16	74 11/16	77 1/8
March	84 1/8	76	57 13/16	57 1/16	65 7/16	79 13/16	103 3/8	70 1/4	65 1/2	74 3/4	72 7/8	73 1/16
April	81 5/16	79	61 1/8	61 1/2	66 1/8	80 9/16	112 1/4	73 1/4	66 1/4	72 3/16	73 3/8	75 5/16
May	82 7/8	72 1/4	56 9/16	73 1/16	62 3/8	83 5/16	151	73 15/16	65 9/16	72 9/16	74 5/16	77 11/16
June	82 7/8	65 1/16	58 9/16	76 9/16	60 5/16	75 3/16	97 1/2	75 1/4	76 11/16	71 3/8	73 1/2	80 1/16
July	78 1/4	60 1/8	55 7/16	68	58 1/4	74	76 7/8	72	77 3/4	67 7/16	75 1/4	79 1/2
August	77 1/16	59 5/8	55	65 3/8	58 1/16	91 1/8	70 1/4	71 3/4	74	71 13/16	72 1/8	83 3/4
September	73 1/8	66 3/16	53	60 1/16	62 1/2	93 3/8	65 3/8	72 1/4	75 15/16	69 9/16	82 1/2	83 3/4
October	71 15/16	63 3/8	53 13/16	60 7/8	73 3/8	93 9/16	66 1/8	71 9/16	74 3/8	69 1/8	71 1/2	82 3/8
November	71 9/16	60 7/8	56 1/2	58 7/8	82 11/16	95 3/4	67	68 1/4	71 15/16	71 7/8	73 5/8	81
December	71 1/4	61 13/16	58 3/16	59 1/4	83 7/8	100 1/2	66 3/8	66 3/4	71 15/16	76 1/4	74 3/16	82 3/8
Yearly average	79 1/8	67 3/4	57 1/16	62 3/8	66 13/16	85 13/16	89 3/4	71 9/16	70 13/16	72	74 5/8	79 1/4

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

OATS.

Oats crop of countries named, 1899–1903.

Country.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	796,178,000	809,126,000	736,809,000	987,843,000	784,094,000
Ontario	92,731,000	92,520,000	80,803,000	109,786,000	113,702,000
Manitoba	23,022,000	9,092,000	28,673,000	35,565,000	34,077,000
Rest of Canada	14,000,000	12,000,000	20,000,000	20,000,000	22,000,000
Total Canada	129,753,000	113,612,000	129,476,000	165,351,000	169,779,000
Total North America	925,931,000	922,738,000	866,285,000	1,153,194,000	953,873,000
Great Britain	118,363,000	118,467,000	113,576,000	134,493,000	128,611,000
Ireland	53,013,000	61,291,000	62,240,000	65,570,000	58,817,000
Total United Kingdom	171,376,000	179,758,000	175,816,000	200,063,000	187,428,000
Sweden	53,698,000	69,272,000	56,971,000	61,362,000	62,979,000
Denmark	37,074,000	40,323,000	37,409,000	40,822,000	36,000,000
Netherlands	16,061,000	17,296,000	16,000,000	19,153,000	18,500,000
Belgium	29,047,000	35,815,000	36,820,000	45,588,000	43,000,000
France	270,437,000	250,597,000	225,283,000	276,948,000	315,395,000
Spain	12,776,000	10,000,000	12,000,000	12,000,000	11,000,000
Italy	16,504,000	16,000,000	15,000,000	13,000,000	16,000,000
Germany	474,179,000	488,594,000	485,716,000	514,452,000	542,432,000
Austria	122,168,000	118,181,000	118,191,000	125,473,000	128,328,000
Hungary	81,217,000	70,637,000	68,083,000	82,807,000	87,334,000
Croatia-Slavonia	6,316,000	5,564,000	5,814,000	6,301,000	6,588,000
Total Austria-Hungary	209,701,000	194,382,000	192,088,000	214,581,000	222,250,000
Roumania	6,255,000	8,704,000	16,540,000	21,905,000	31,405,000
Bulgaria	5,775,000	6,000,000	8,000,000	10,000,000	7,234,000
Russia proper	839,639,000	744,037,000	527,576,000	807,888,000	650,405,000
Poland	56,463,000	51,235,000	56,150,000	63,167,000	58,745,000
North Caucasus	12,546,000	17,519,000	11,932,000	16,112,000	18,939,000
Total Russia in Europe	908,648,000	812,791,000	595,658,000	887,167,000	728,089,000
Total Europe	2,211,531,000	2,129,532,000	1,873,301,000	2,317,041,000	2,221,712,000
Siberia	76,853,000	34,918,000	21,569,000	34,078,000	71,694,000
Central Asia	9,804,000	5,987,000	6,870,000	9,433,000	
Total Russia in Asia	86,657,000	40,905,000	28,439,000	43,511,000	71,694,000
Total Asia	86,657,000	40,905,000	28,439,000	43,511,000	71,694,000

Oats crop of countries named, 1899-1903—Continued.

Country.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Algeria	4,534,000	5,000,000	5,000,000	8,729,000	5,000,000
Cape Colony	1,868,000	1,750,000	1,750,000	1,750,000	1,500,000
Total Africa	6,402,000	6,750,000	6,750,000	10,479,000	6,500,000
West Australia	58,000	76,000	90,000	164,000	167,000
South Australia	314,000	225,000	378,000	484,000	640,000
Queensland	4,000	11,000	8,000	44,000	1,000
New South Wales	287,000	648,000	612,000	709,000	363,000
Victoria	5,697,000	6,309,000	9,884,000	6,937,000	4,542,000
Tasmania	2,343,000	1,184,000	1,451,000	1,756,000	1,808,000
New Zealand	17,032,000	16,840,000	19,687,000	15,519,000	22,452,000
Total Australasia	25,735,000	25,293,000	32,110,000	25,613,000	29,973,000

RECAPITULATION BY CONTINENTS.

	1899.	1900.	1901.	1902.	1903.
North America	925,931,000	922,738,000	866,285,000	1,153,194,000	953,873,000
Europe	2,211,531,000	2,129,532,000	1,873,301,000	2,317,041,000	2,221,712,000
Asia	86,657,000	40,905,000	28,439,000	43,511,000	71,694,000
Africa	6,402,000	6,750,000	6 750,000	10,479,000	6,500,000
Australasia	25,735,000	25,293,000	32,110,000	25,613,000	29,973,000
Total	3,256,256,000	3,125,218,000	2,806,885,000	3,549,838,000	3,283,752,000

Visible supply of oats in the United States and Canada, first of each month, for ten years.[a]

Month.	1894-1895.	1895-1896.	1896-1897.	1897-1898.	1898-1899.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	3,134,000	9,007,000	14,120,000	12,912,000	8,716,000
August	2,135,000	4,653,000	10,384,000	9,604,000	4,971,000
September	9,380,000	4,673,000	11,410,000	13,784,000	7,360,000
October	10,765,000	4,124,000	13,821,000	15,573,000	9,286,000
November	12,738,000	8,020,000	17,217,000	20,096,000	11,352,000
December	12,332,000	10,248,000	17,995,000	19,768,000	9,460,000
January	11,864,000	10,446,000	19,538,000	16,148,000	10,893,000
February	10,508,000	11,446,000	19,978,000	20,245,000	13,231,000
March	9,227,000	12,211,000	20,832,000	17,925,000	14,782,000
April	8,905,000	14,326,000	20,672,000	15,609,000	15,725,000
May	7,823,000	13,426,000	16,138,000	14,402,000	13,971,000
June	11,284,000	13,460,000	12,878,000	10,421,000	13,661,000

Month.	1899-1900.	1900-1901.	1901-1902.	1902-1903.	1903-1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	10,262,000	12,716,000	15,275,000	2,420,000	6,686,000
August	6,885,000	9,364,000	7,808,000	2,988,000	8,623,000
September	10,973,000	13,853,000	10,603,000	5,159,000	11,714,000
October	13,127,000	17,140,000	14,445,000	11,241,000	10,876,000
November	13,251,000	20,528,000	12,899,000	10,661,000	13,332,000
December	11,789,000	18,136,000	10,109,000	10,401,000	13,995,000
January	12,001,000	15,861,000	8,680,000	8,794,000	13,785,000
February	11,876,000	16,175,000	8,537,000	8,727,000	14,774,000
March	12,449,000	16,800,000	8,207,000	12,437,000	15,241,000
April	14,176,000	15,823,000	6,606,000	12,432,000	15,377,000
May	13,845,000	16,824,000	5,010,000	9,992,000	....
June	12,301,000	14,989,000	4,571,000	7,160,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Condition of oats crop of United States, 1886–1903.

Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.
1886	95.9	88.8	87.4	90.9	1892	88.5	87.2	86.2	78.9	1898	98.0	92.8	84.2	79.0
1887	91.0	85.9	85.6	83.4	1893	88.9	88.8	78.3	74.9	1899	88.7	90.0	90.8	87.2
1888	95.4	95.2	91.7	87.2	1894	87.0	77.7	76.5	77.8	1900	91.7	85.5	85.0	82.9
1889	93.8	94.1	92.3	90.0	1895	84.3	83.2	84.5	86.0	1901	85.3	83.7	73.6	72.1
1890	89.8	81.6	70.1	64.4	1896	98.8	96.3	77.3	74.0	1902	90.6	92.1	89.4	87.2
1891	85.1	87.6	89.5	90.7	1897	89.0	87.5	86.0	84.6	1903	85.5	84.3	79.5	75.7

Acreage, production, value, prices, exports, etc., of oats of the United States, 1866–1903.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	Chicago cash price per bushel, No. 2. December. High.	Chicago cash price per bushel, No. 2. May of following year. Low.	Chicago cash price per bushel, No. 2. May of following year. High.	Domestic exports, including oatmeal, fiscal years beginning July 1.[a]	Imports during fiscal years beginning July 1.[a]
	Acres.	Bush.	Bushels.	Cts.	Dollars.	Cts.	Cts.	Cts.	Cts.	Bushels.	Bushels.
1866	8,864,219	30.2	268,141,077	35.1	94,057,945	36	43	59	78	825,895	778,198
1867	10,746,416	25.9	278,698,000	44.5	123,902,556	52	57¼	......	......	122,554	780,798
1868	9,665,736	26.4	254,960,800	41.7	106,355,976	43	49½	56¾	62½	481,871	326,659
1869	9,461,441	30.5	288,334,000	38.0	109,521,734	40	44¾	46½	53½	121,517	2,266,785
1870	8,792,395	28.1	247,277,400	39.0	96,443,637	37¾	41	47¼	51	147,572	599,514
1871	8,365,809	30.6	255,743,000	36.2	92,591,359	30¾	33	34¾	42½	262,975	535,250
1872	9,000,769	30.2	271,747,000	29.9	81,303,518	23½	25¾	30	34	714,072	225,555
1873	9,751,700	27.7	270,340,000	34.6	93,474,161	34	40⅝	44	48½	812,873	191,802
1874	10,897,412	22.1	240,369,000	47.1	113,133,934	51¾	54½	57¼	64½	504,770	1,500,040
1875	11,915,075	29.7	354,317,500	32.0	113,441,491	29½	30½	28⅝	31½	1,466,228	121,547
1876	13,358,908	24.0	320,884,000	32.4	103,844,896	31¾	34½	37¼	45¾	2,854,128	41,597
1877	12,826,148	31.7	406,394,000	28.4	115,546,194	24⅛	27	23	27	3,715,479	21,391
1878	13,176,500	31.4	413,578,560	24.6	101,752,468	19⅝	20⅜	24⅜	30½	5,452,136	13,395
1879	12,683,500	28.7	363,761,320	33.1	120,533,294	32¾	36¾	29½	34⅞	766,366	489,576
1880	16,187,977	25.8	417,885,380	36.0	150,243,565	29⅛	33½	36¼	39½	402,904	64,412
1881	16,831,600	24.7	416,481,000	46.4	193,198,970	43½	46¾	48¾	56⅜	625,690	1,850,983
1882	18,494,691	26.4	488,250,610	37.5	182,978,022	34¾	41½	38¾	42¾	461,496	815,017
1883	20,324,962	28.1	571,302,400	32.7	187,040,264	29⅜	36⅛	30¾	34¼	3,274,622	121,069
1884	21,300,917	27.4	583,628,000	27.7	161,528,470	22½	25¼	34½	37	6,203,104	94,310
1885	22,783,630	27.6	629,409,000	28.5	179,631,860	27	29	26¼	29⅜	7,311,306	149,480
1886	23,658,474	26.4	624,134,000	29.8	186,137,930	25¾	27¼	25⅛	27½	1,374,635	139,575
1887	25,920,906	25.4	659,618,000	30.4	200,699,790	28⅝	30⅞	32½	38	573,080	123,817
1888	26,998,282	26.0	701,735,000	27.8	195,424,240	25	26⅞	21⅝	23⅝	1,191,471	131,501
1889	27,462,316	27.4	751,515,000	22.9	171,781,008	20	21	24¾	30	15,107,238	153,232
1890	26,431,369	19.8	523,621,000	42.4	222,048,486	39⅞	43⅞	45¼	54	1,382,836	41,848
1891	25,581,861	28.9	738,394,000	31.5	232,312,267	31⅛	33⅝	28⅛	33½	10,586,644	47,782
1892	27,063,835	24.4	661,035,000	31.7	209,253,611	25⅝	31¼	28¾	32¼	2,700,793	49,433
1893	27,273,033	23.4	638,854,850	29.4	187,576,092	27½	29⅛	32½	36	6,290,229	31,759
1894	27,023,553	24.5	662,036,928	32.4	214,816,920	28¾	29⅜	27½	30¾	1,708,824	330,318
1895	27,878,406	29.6	824,443,537	19.9	163,655,068	16⅝	17½	18	19⅜	15,156,618	66,602
1896	27,565,985	25.7	707,346,440	18.7	132,485,033	16½	18¾	16⅞	18¾	37,725,083	131,204
1897	25,730,375	27.2	698,767,809	21.2	147,974,719	21	23⅞	26	32	73,880,307	25,093
1898	25,777,110	28.4	730,906,643	25.5	186,405,364	26	27¾	24	27¾	33,534,362	28,098
1899	26,341,380	30.2	796,177,713	24.9	198,167,975	22¼	23	21¼	23¾	45,048,857	54,576
1900	27,364,795	29.6	809,125,989	25.8	208,669,233	21¾	22¾	27⅞	31	42,268,931	32,107
1901	28,541,476	25.8	736,808,724	39.9	293,658,777	42	48¼	41	49½	13,277,612	38,978
1902	28,653,144	34.5	987,842,712	30.7	303,584,852	29¼	32	33⅜	38¼	8,381,805	150,065
1903	27,638,126	28.4	784,094,199	34.1	267,661,665	34¼	38	......	......	....	....

[a] In years 1866 to 1882, inclusive, oatmeal is not included.

Losses on Oats by Shrinkage.

Experiments with oats indicate that the grain, after having passed through the sweating process, shrinks but little. The highest shrinkage observed in the tests recorded was 3.4 per cent during a period of about 7 months.

Acreage, production, value, and distribution of oats of the United States in 1903, by States.

States and Territories.	Crop of 1903. Acreage.	Production.	Value.	Stock in farmers' hands March 1, 1904.		Shipped out of county where grown.
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	119,955	4,738,222	2,132,200	1,658,378	35	94,764
New Hampshire	12,053	374,848	179,927	101,209	27	....
Vermont	79,336	3,030,635	1,333,479	939,497	31	30,306
Massachusetts	6,842	216,891	106,277	45,547	21	....
Rhode Island	1,688	47,433	21,345	12,333	26	....
Connecticut	10,283	320,830	144,374	70,583	22	....
New York	1,311,318	44,584,812	18,279,773	20,063,165	45	4,012,633
New Jersey	63,781	1,620,037	696,616	615,614	38	48,601
Pennsylvania	1,209,191	34,582,863	12,795,659	14,178,974	41	1,729,143
Delaware	4,823	107,071	42,828	28,909	27	6,424
Maryland	38,340	789,804	315,922	189,553	24	102,675
Virginia	206,529	2,850,100	1,225,543	798,028	28	199,507
North Carolina	216,710	2,470,494	1,284,657	395,279	16	123,525
South Carolina	203,549	2,849,686	1,681,315	284,969	10	56,994
Georgia	256,093	3,482,865	1,915,576	522,430	15	69,657
Florida	33,227	438,596	263,158	61,403	14	21,930
Alabama	214,986	3,396,779	1,834,261	543,485	16	33,968
Mississippi	110,374	1,655,610	844,361	215,229	13	16,556
Louisiana	32,137	510,978	235,050	86,866	17	....
Texas	914,806	32,475,613	14,289,270	6,170,366	19	8,118,903
Arkansas	227,178	4,225,511	1,859,225	1,098,633	26	253,531
Tennessee	169,325	3,132,512	1,315,655	751,803	24	313,251
West Virginia	84,758	1,839,249	846,055	680,522	37	36,785
Kentucky	230,862	4,640,326	1,902,534	1,392,098	30	278,420
Ohio	1,004,981	30,752,419	11,070,871	10,455,822	34	8,610,677
Michigan	970,590	29,602,995	10,657,078	10,065,018	34	7,696,779
Indiana	1,207,283	29,457,705	9,426,466	8,248,157	28	12,666,813
Illinois	3,703,976	98,525,762	31,528,244	34,484,017	35	60,100,715
Wisconsin	2,429,538	79,688,846	27,094,208	31,078,650	39	15,140,881
Minnesota	2,130,315	68,809,174	20,642,752	26,147,486	38	22,018,936
Iowa	3,505,581	84,133,944	24,398,844	26,081,523	31	21,874,825
Missouri	787,411	17,401,783	5,568,571	5,916,606	34	2,436,250
Kansas	992,815	26,011,753	7,803,526	9,104,114	35	4,682,116
Nebraska	2,014,463	59,426,658	16,045,198	20,799,330	35	26,147,730
South Dakota	706,404	27,267,194	7,907,486	12,542,909	46	8,452,830
North Dakota	797,263	21,845,006	6,771,952	9,611,803	44	3,058,301
Montana	162,337	7,532,437	2,636,353	3,238,948	43	2,259,731
Wyoming	37,988	1,116,847	558,424	435,570	39	67,011
Colorado	137,942	4,593,469	1,883,322	1,653,649	36	1,378,041
New Mexico	15,272	345,147	213,991	106,996	31	27,612
Arizona	1,816	64,468	39,325	19,340	30	6,447
Utah	45,420	1,653,288	810,111	611,717	37	363,723
Nevada	6,205	177,463	120,675	53,239	30	8,873
Idaho	88,360	3,666,940	1,650,123	1,173,421	32	1,356,768
Washington	158,626	7,598,185	2,887,310	2,203,474	29	2,583,383
Oregon	287,594	9,720,677	4,277,098	3,402,237	35	3,693,857
California	165,430	5,756,964	3,108,761	633,266	11	1,611,950
Oklahoma	307,736	8,124,230	2,762,238	2,031,058	25	1,137,392
Indian Territory	214,636	6,439,080	2,253,678	2,704,414	42	1,030,253
United States	27,638,126	784,094,199	267,661,665	273,707,637	34.9	223,959,467

Oats as a Forage Crop.

A mixed crop of oats and Canadian field peas is well worthy of a place on every farm where stock is kept. Such a mixed crop is recommended as being valuable for pasture, for cutting as a soiling crop, and, when mature, for hay. When planted in succession of about two weeks, the first planting being as early in the spring as conditions will permit, a succession of highly nutritious forage is produced which is greatly relished by stock.

In comparative tests of oats and peas, oats, barley and oats, and barley, the average yields were nearly 12, 8, 7.5, and 6.5 tons per acre, respectively. The estimated value of the food constituents per acre, calculated on the dry matter, is given as $63.11 for oats and peas, $57.99 for oats alone, $43.39 for oats and barley, and $31.99 for barley alone.

Average yield per acre of oats in the United States, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	33.5	40.1	40.0	31.0	36.0	35.0	37.5	35.0	39.0	39.5
New Hampshire	31.1	36.9	38.0	35.0	33.0	35.0	32.6	29.5	35.0	31.1
Vermont	32.9	43.8	40.5	33.0	38.0	37.0	34.9	33.0	40.0	38.2
Massachusetts	31.9	36.0	36.0	32.0	32.0	33.0	36.8	31.0	32.2	31.7
Rhode Island	30.0	32.4	30.0	32.0	27.0	26.0	30.9	29.4	36.2	28.1
Connecticut	25.8	31.9	29.0	29.0	28.2	28.0	31.0	28.7	34.5	31.2
New York	22.1	31.7	33.0	31.0	27.5	31.0	27.9	21.6	40.0	34.0
New Jersey	28.4	35.5	34.0	25.0	19.6	24.0	29.6	16.0	32.2	25.4
Pennsylvania	22.3	31.7	31.0	28.2	23.3	33.0	31.1	18.9	36.5	28.6
Delaware	19.0	19.1	29.0	22.0	22.0	20.0	21.0	18.5	22.6	22.2
Maryland	21.4	26.2	24.0	24.0	19.5	23.0	24.0	18.8	26.7	20.6
Virginia	12.0	17.7	18.5	12.0	16.1	14.0	14.8	14.9	17.5	13.8
North Carolina	10.9	15.1	12.0	13.0	14.3	12.0	13.9	14.4	12.7	11.4
South Carolina	12.0	15.2	11.0	15.5	17.2	12.0	15.5	15.8	13.1	14.0
Georgia	13.4	14.5	12.0	14.0	16.6	9.0	15.0	14.8	11.1	13.6
Florida	11.8	10.2	12.0	9.0	15.4	9.0	11.3	13.1	13.6	13.2
Alabama	13.2	14.9	14.0	13.0	16.8	10.0	14.4	14.5	10.9	15.8
Mississippi	13.0	15.7	13.0	14.0	18.5	10.0	14.0	15.2	15.4	15.0
Louisiana	22.3	15.0	10.0	18.0	18.1	18.0	18.0	13.4	15.2	15.9
Texas	32.7	20.7	20.0	25.0	29.7	25.0	38.0	16.3	23.2	35.5
Arkansas	18.5	25.4	16.0	17.0	22.8	19.0	22.2	12.3	20.0	18.6
Tennessee	14.6	22.5	16.5	10.0	18.7	14.0	16.6	17.5	17.3	18.5
West Virginia	18.5	23.4	24.0	20.0	19.5	23.0	21.0	18.7	28.6	21.7
Kentucky	21.0	26.2	21.0	18.0	22.4	18.0	21.3	19.7	22.2	20.1
Ohio	30.3	31.7	31.0	32.0	30.9	36.0	38.0	31.5	41.1	30.6
Michigan	26.1	23.9	30.0	26.0	32.8	34.0	36.7	29.0	39.9	30.5
Indiana	32.3	22.9	29.0	30.2	29.2	32.0	32.7	28.6	35.4	24.4
Illinois	36.1	24.4	28.0	32.0	29.0	38.0	38.0	28.2	37.7	26.6
Wisconsin	32.9	33.8	33.4	34.0	36.1	36.0	32.0	29.1	39.9	32.8
Minnesota	28.1	39.9	33.0	26.0	36.3	32.0	25.2	32.1	39.0	32.3
Iowa	25.6	46.2	27.5	30.0	34.0	33.0	34.0	29.8	30.7	24.0
Missouri	23.3	27.7	18.0	22.0	17.0	25.0	27.4	11.2	32.5	22.1
Kansas	17.9	17.9	13.0	24.0	18.0	29.0	31.6	18.6	33.5	26.2
Nebraska	12.6	23.8	19.0	31.0	32.1	30.0	21.8	19.8	34.6	29.5
South Dakota	7.6	25.3	27.5	22.0	26.8	26.0	21.5	28.8	34.8	38.6
North Dakota	25.9	32.1	22.0	23.0	30.7	30.0	10.3	32.6	38.4	27.4
Montana	40.1	35.8	47.0	42.0	40.6	38.0	39.0	42.0	41.9	46.4
Wyoming	30.4	41.0	32.0	35.0	31.2	30.0	34.2	41.0	36.0	29.4
Colorado	13.5	34.3	28.0	34.0	35.8	27.0	32.8	33.8	26.8	33.3
New Mexico	35.0	39.9	27.0	35.5	38.8	24.0	30.1	31.6	19.1	22.6
Arizona	......	......	......	......	......	......	......	35.0	31.7	35.5
Utah	33.0	33.8	38.0	35.0	39.7	34.0	35.9	33.0	35.5	36.4
Nevada	......	......	......	......	......	......	......	43.0	34.8	28.6
Idaho	38.5	35.2	42.0	36.3	43.6	34.0	36.6	38.3	42.1	41.5
Washington	36.5	40.3	36.0	48.0	41.9	37.0	34.4	47.5	46.2	47.9
Oregon	26.7	28.8	21.0	32.0	27.0	30.0	18.5	31.5	28.7	33.8
California	35.6	28.1	31.0	18.0	33.0	31.0	24.6	30.4	30.5	34.8
Oklahoma	......	......	......	......	......	......	......	20.7	47.8	26.4
Indian Territory	......	......	......	......	......	......	......	25.0	32.6	30.0
General average	24.5	29.6	25.7	27.2	28.4	30.2	29.6	25.8	34.5	28.4

Average yield of oats in certain countries, in bushels per acre, 1894–1902.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(*a*)	(*b*)	(*b*)	(*b*)	(*b*)	(*a*)	(*a*)
1894	24.5	21.7	46.8	25.9	30.1	27.2	43.7
1895	29.6	19.9	43.2	26.2	29.6	27.5	39.5
1896	25.7	19.2	41.8	23.1	31.4	27.0	39.2
1897	27.2	15.7	39.9	21.5	24.3	23.1	40.1
1898	28.4	16.5	47.1	27.3	30.2	29.0	43.6
1899	30.2	23.6	48.0	30.2	33.3	27.8	41.8
1900	29.6	19.5	48.0	25.2	28.1	25.7	41.2
1901	25.8	14.0	44.5	25.6	28.1	23.5	40.6
1902	34.5	21.6	50.2	27.6	33.6	29.2	45.9
Average	28.4	19.1	45.5	25.8	29.9	26.7	41.7

a Winchester bushels. *b* Bushels of 32 pounds.

Average value per acre of oats in the United States, based upon farm value December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$14.74	$13.63	$12.40	$9.92	$12.24	$13.30	$14.25	$17.50	$17.55	$17.77
New Hampshire	15.24	12.92	13.30	13.30	12.54	13.65	12.39	15.34	15.40	14.93
Vermont	16.78	14.37	12.56	10.56	13.30	13.69	12.56	16.50	17.20	16.81
Massachusetts	13.72	12.24	12.60	10.56	11.84	12.54	13.98	17.05	14.49	15.53
Rhode Island	14.10	12.64	9.30	10.88	9.99	9.62	11.74	15.88	15.57	12.65
Connecticut	11.09	9.89	8.99	9.86	10.15	10.36	10.85	15.50	14.14	14.04
New York	8.62	8.88	8.58	8.37	8.53	10.23	8.93	10.37	14.40	13.94
New Jersey	10.79	10.29	9.52	7.50	6.08	7.92	9.18	7.52	12.56	10.92
Pennsylvania	8.47	8.56	7.43	7.61	6.99	9.57	9.33	8.50	12.41	10.58
Delaware	6.65	5.54	6.09	5.06	6.60	5.00	6.30	8.33	9.49	8.88
Maryland	8.35	7.07	5.52	6.24	5.65	6.90	7.44	7.71	10.15	8.24
Virginia	4.44	5.31	4.81	3.48	4.67	4.62	5.48	6.26	7.35	5.93
North Carolina	4.80	5.74	4.20	4.81	5.29	4.92	6.26	7.34	6.48	5.93
South Carolina	6.36	7.45	5.28	6.98	7.74	5.64	7.44	9.80	7.73	8.26
Georgia	6.83	6.67	4.92	5.88	7.97	4.32	7.35	9.92	5.88	7.48
Florida	7.20	6.63	6.36	4.77	8.32	4.50	5.65	9.43	8.30	7.92
Alabama	6.73	6.26	5.74	5.59	6.89	4.30	6.34	9.28	6.00	8.53
Mississippi	6.11	6.12	5.72	6.16	7.77	5.00	6.44	9.58	7.85	7.65
Louisiana	10.48	5.40	3.40	6.84	6.88	7.20	7.20	8.04	7.60	7.31
Texas	12.75	5.38	6.80	6.75	8.32	7.50	11.40	9.78	11.37	15.62
Arkansas	7.40	8.13	4.96	5.61	6.61	6.46	7.77	7.01	8.20	8.18
Tennessee	5.11	6.08	4.29	2.80	5.24	4.48	5.81	7.87	7.27	7.77
West Virginia	7.21	7.49	6.72	6.00	5.85	8.05	7.14	8.04	11.73	9.98
Kentucky	7.56	6.81	5.04	4.86	6.05	5.76	6.60	8.08	7.99	8.24
Ohio	9.39	6.97	5.27	6.40	7.42	9.60	9.88	12.28	13.15	11.02
Michigan	8.87	5.50	5.70	5.98	8.86	9.52	9.54	11.89	13.17	10.98
Indiana	9.69	4.58	4.64	5.74	6.72	7.36	7.52	10.87	9.91	7.81
Illinois	10.47	4.15	4.20	5.76	6.67	8.36	8.74	11.28	10.56	8.51
Wisconsin	9.87	6.08	5.95	6.46	8.66	8.28	7.36	11.35	11.97	11.15
Minnesota	8.43	5.59	4.95	4.94	7.62	7.04	6.05	10.91	10.53	9.69
Iowa	7.17	6.47	3.30	4.80	8.16	6.27	6.80	10.73	7.67	6.96
Missouri	6.76	4.99	3.06	4.18	3.91	6.00	6.30	4.82	9.10	7.07
Kansas	5.55	3.04	2.08	4.32	3.96	6.38	7.27	8.00	10.05	7.86
Nebraska	4.54	3.33	2.09	4.65	6.42	6.60	5.23	7.33	8.65	7.97
South Dakota	2.65	4.35	3.58	3.96	5.63	5.98	5.16	9.79	10.09	11.19
North Dakota	7.51	5.14	3.96	5.98	7.98	8.10	3.30	10.76	10.37	8.49
Montana	12.43	15.75	14.57	13.86	14.21	14.82	16.38	15.12	15.08	16.24
Wyoming	14.59	15.99	16.96	12.25	12.48	12.00	16.07	19.68	18.00	14.70
Colorado	6.21	9.60	8.40	10.88	14.68	11.34	14.10	16.90	13.67	13.65
New Mexico	17.50	17.96	10.80	14.56	15.91	10.56	14.45	18.96	12.99	14.01
Arizona	......	......	......	......	......	......	......	21.00	23.78	21.65
Utah	11.22	10.14	14.82	11.55	15.09	13.60	15.80	16.83	16.68	17.84
Nevada	......	......	......	......	......	......	......	30.10	24.36	19.45
Idaho	12.32	10.21	12.60	11.62	15.70	12.92	14.64	16.85	20.21	18.68
Washington	11.32	11.28	14.40	16.80	16.76	14.06	13.76	16.63	22.64	18.20
Oregon	7.48	7.78	6.93	11.20	10.80	12.30	7.59	10.71	11.77	14.87
California	15.66	10.96	13.64	8.82	16.50	14.57	11.32	13.38	15.55	18.79
Oklahoma	......	......	......	......	......	......	......	10.35	16.25	8.98
Indian Territory	......	......	......	......	......	......	......	11.50	12.06	10.50
General average	7.95	5.87	4.81	5.75	7.23	7.52	7.63	10.29	10.60	9.68

Control of Smut in Oats.

Smut in oats was so destructive to that crop in the Northwest a few years ago that some of the sufferers from its ravages were inclined to give up growing oats altogether. But a new and powerful disinfectant had been introduced. This was formaldehyde, a derivative of wood alcohol. It was found almost at once that formaldehyde would kill many forms of microscopic animal and vegetable growth. This suggested its application for freeing cereals from smut fungi. Experiments were made at the North Dakota Experiment Station, which demonstrated that formaldehyde was a very satisfactory remedy for smut in oats. The spread of the information that relief had been found was very rapid, and thousands of farmers immediately availed themselves of it. In the Dakotas, Minnesota, and Wisconsin the total saving was over $5,000,000, and probably more than thirty thousand families were directly benefited.

This is a valuable proof of the ready availability of successful new methods of cultivation and crop protection under the existing system of publishing the results of investigation and experiment.

Average farm price of oats per bushel in the United States December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	44	34	31	32	34	38	38	50	45	45
New Hampshire	49	35	35	38	38	39	38	52	44	48
Vermont	51	33	31	32	35	37	36	50	43	44
Massachusetts	43	34	35	33	37	38	38	55	45	49
Rhode Island	47	39	31	34	37	37	38	54	43	45
Connecticut	43	31	31	34	36	37	35	54	41	45
New York	39	28	26	27	31	33	32	48	36	41
New Jersey	38	29	28	30	31	33	31	47	39	43
Pennsylvania	38	27	24	27	30	29	30	45	34	37
Delaware	35	29	21	23	30	25	30	45	42	40
Maryland	39	27	23	26	29	30	31	41	38	40
Virginia	37	30	26	29	29	33	37	42	42	43
North Carolina	44	38	35	37	37	41	45	51	51	52
South Carolina	53	49	48	45	45	47	48	62	59	59
Georgia	51	46	41	42	48	48	49	67	53	55
Florida	61	65	53	53	54	50	50	72	61	60
Alabama	51	42	41	43	41	43	44	64	55	54
Mississippi	47	39	44	44	42	50	46	63	51	51
Louisiana	47	36	34	38	38	40	40	60	50	46
Texas	39	26	34	27	28	30	30	60	49	44
Arkansas	40	32	31	33	29	34	35	57	41	44
Tennessee	35	27	26	28	28	32	35	45	42	42
West Virginia	39	32	28	30	30	35	34	43	41	46
Kentucky	36	26	24	27	27	32	31	41	36	41
Ohio	31	22	17	20	24	25	26	39	32	36
Michigan	34	23	19	23	27	28	26	41	33	36
Indiana	30	20	16	19	23	23	23	38	28	32
Illinois	29	17	15	18	23	22	23	40	28	32
Wisconsin	30	18	17	19	24	23	23	39	30	34
Minnesota	30	14	15	19	21	22	24	34	27	30
Iowa	28	14	12	16	24	19	20	36	25	29
Missouri	29	18	17	19	23	24	23	43	28	32
Kansas	31	17	16	18	22	22	23	43	30	30
Nebraska	36	14	11	15	20	22	24	37	25	27
South Dakota	35	17	13	18	21	23	24	34	29	29
North Dakota	29	16	18	26	26	27	32	33	27	31
Montana	31	44	31	33	35	39	42	36	36	35
Wyoming	48	39	53	35	40	40	47	48	50	50
Colorado	46	28	30	32	41	42	43	50	51	41
New Mexico	50	45	40	41	41	44	48	60	68	62
Arizona	......	......	......	......	......	......	......	60	75	61
Utah	34	30	39	33	38	40	44	51	47	49
Nevada	......	......	......	......	......	......	......	70	70	68
Idaho	32	29	30	32	36	38	40	44	48	45
Washington	31	28	40	35	40	38	40	35	49	38
Oregon	28	27	33	35	40	41	41	34	41	44
California	41	39	44	49	50	47	46	44	51	54
Oklahoma	......	......	......	......	......	......	......	50	34	34
Indian Territory	......	......	......	......	......	......	......	46	37	35
General average	32.4	19.9	18.7	21.2	25.5	24.9	25.8	39.9	30.7	34.1

Transportation rates, average for oats in sacks, in cents per 100 pounds, St. Louis to New Orleans, by river.

1883	17.75	1890	15.66	1897	10.83
1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00
1888	15.00	1895	13.00	1902	10.00
1889	17.93	1896	14.54	1903	10.00

Wholesale prices of oats per bushel in leading cities of the United States, 1898–1903.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Milwaukee.		Duluth.		Detroit.		San Francisco.	
	No. 2, mixed.		No. 2, mixed.		No. 2, mixed.		No. 2.		No. 2, white.		No. 2.		No. 2, white.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
1898.																
January	28¼	29¼	27½	28	24	26	21½	24	23¾	25¼	23½	25	24½	26¾	$1.15	$1.22½
February	29	32	28	33	25½	28¾	24	27	24¾	29	24	28	26½	32¼	1.20	1.22½
March	30	32	30	32½	27½	29	24⅞	26¾	28	30	24¾	27¼	29¾	30¾	1.20	1.30
April	29¾	35½	30	35	28	31	25	31⅞	28	33	25	32¾	30¼	32½	1.30	1.42½
May	32½	36	33	36	29	34½	26	32	28¾	34½	27	33¼	30¼	36¼	1.40	1.42½
June	27¾	32½	27½	33	25½	28	21	26½	24	29½	22½	28	27	30¼	1.35	1.37½
July	25½	28	26½	32	23½	27	20¾	26	26¼	29	23	25	26¼	29¾	1.30	1.37½
August	26¾	28½	24	33	21½	24¼	20¼	22½	22¼	28¼	20	24	24¼	27¼	1.22½	1.32½
September	25½	26¾	24	26	22	25	20¼	22⅜	22¼	25½	21	23¾	23¼	25¾	1.17½	1.27½
October	25¾	29½	25½	28	23	26½	21½	25	24	27¾	23	25½	24¾	29	1.22½	1.27½
November	29	30¾	27½	32	26½	29	24¼	27¾	27	30	25	27	28½	29½	1.22½	1.27½
December	30⅝	33¾	31½	32½	28	30	26	27¾	22¾	30	26¾	30	29½	30¾	1.25	1.32½
1899.																
January	33	35	32	33½	28½	31	26¼	27¾	28¼	31¼	28¾	30½	30½	33	1.30	1.30
February	34¼	35½	33	35	28¾	31½	26¾	28¼	29½	31½	28¼	30	32½	33	1.30	1.32½
March	32	35¼	32	34	28½	31	25¼	27¾	28¾	31	25¾	29¼	31	32¾	1.35	1.40
April	32½	33½	32	33	29	30½	26⅜	27¼	29½	31	27¼	28	32¼	33	1.40	1.40
May	31	32½	29½	33	27½	29½	24	27¾	26¾	31	26½	28	30¼	32¾	1.42½	1.45
June	30½	31½	29½	31	27	29	24¼	26¼	26¾	29¼	26⅛	28½	28¾	30¼	1.42½	1.45
July	28	30½	28½	31	22	28½	19⅞	25	24	28	22½	26¾	25½	30	1.35	1.40
August	26	27½	24½	29	21½	22½	19¼	22	23	26	19½	23¼	23½	25½	1.27½	1.35
September	25¾	29	25	28	22½	25½	21	23¼	22¾	26	20¼	24	23¾	28½	1.17½	1.22½
October	28½	29¼	27½	29	24¾	26	22	23½	24¾	26	22¼	24¼	26	27½	1.20	1.25
November	28½	30	27½	29½	25¼	26½	22½	24	25¼	26½	22½	23¾	27	28	1.25	1.25
December	28½	30	28	29½	25½	26¾	22¼	23	24¾	25½	22½	23¼	26½	27½	1.25	1.25
1900.																
January	29	29¾	28	29½	25¼	26½	22½	23	25	26	23	24	26¼	28½	1.25	1.30
February	29	29½	28¾	29½	25¼	26	22½	23¾	25	26	24	24	27¼	28½	1.25	1.25
March	28½	29½	28	29½	25¼	26½	23	24½	25	27	24	24	27¼	28½	1.25	1.26¼
April	27½	29½	27¾	29¼	26	28	23	25¼	26½	29	24	24½	28¼	29	1.25	1.26¼
May	26	28	26½	28¼	24½	26½	21¼	23¾	24	27½	23	24½	27	28½	1.22½	1.25
June	26	29¾	26	29	24	27	21¾	26¼	24¼	28½	23	28	26	29¼	1.22½	1.25
July	26½	29	27	28½	25	28	21½	24¾	24¾	28½	23¾	28	28	28½	1.25	1.30
August	25½	26½	24	27	21	25	21	22⅝	24½	27¼	23¼	24½	24½	28	1.27½	1.30
September	24¾	25½	24½	25¾	22¼	23½	21⅛	22¼	24¾	26	22½	23¾	24¾	26	1.27½	1.27½
October	25	26	24¾	25½	23	24	21⅜	22⅝	24¾	26	23¼	24	25¼	26	1.30	1.32½
November	25½	26¾	24¾	26	23	25	21¾	22½	24¾	26¼	23¼	23¼	24	26½	1.35	1.35
December	26½	28½	26	29	24	25½	21¾	22¾	25½	26¼	23½	24¾	27	28	1.35	1.40

Wholesale prices of oats per bushel in leading cities of the United States, 1898–1903—Continued.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Milwaukee.		Duluth.		Detroit.		San Francisco.	
	No. 2, mixed.		No. 2, mixed.		No. 2, mixed.		No. 2.		No. 2, white.		No. 2.		No. 2, white.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	28¼	31	28	29	25	27½	23¼	24¼	25½	27½	25¼	26¼	28	28½	$1.17½	$1.45
February	30	31	28	30	26¾	28	24⅛	25½	27	28¼	26¼	26¾	28½	30	1.20	1.42½
March	30½	31½	29¾	31	27½	28	24¾	26½	27½	28¾	25¼	27¼	29	29¾	1.20	1.45
April	30¾	32	30½	32	28	29	25½	27½	27¾	30½	27	27¼	30	31	1.25	1.50
May	32¼	34	31	32	30	32	27⅞	31	29	30½	27¼	29¼	30½	32½	1.30	1.45
June	32	33	31½	32½	29½	30½	27	28¾	28¾	29¾	27¼	28¼	30	31½	1.40	1.55
July	33½	41½	31½	42	31½	42	27½	39	30¾	41½	27¼	36¼	31½	40½	1.15	1.40
August	38	40½	37¼	42½	37	38	33½	37½	36¾	39½	34⅞	37½	54½	60½	1.10	1.35
September	38	39½	37½	38½	36	38	33⅝	36¾	36¼	38¾	35⅛	37½	36¼	39½	1.10	1.30
October	38	42	38	41½	38	39	34½	37¾	36	40½	35¼	37⅛	38½	40½	1.02½	1.30
November	42½	49	41	49	40	46	37⅛	44⅛	41	46	36⅞	43¼	41½	48½	1.10	1.30
December	49	52	48½	53	47	50¾	42	48¼	45¾	48¾	42¾	46⅞	48½	51	1.20	1.42½
1902.																
January	46½	53	48	52	46	50	38⅛	46¼	44¼	49	40⅜	47⅛	45	50½	1.25	1.40
February	48	50	47	49½	46	48	40¾	44¼	42¾	47	38⅝	43¼	46	47½	1.27½	1.42½
March	46¾	52	47½	49	45½	47	40¼	45½	44	47	40	43	46	48¼	1.25	1.40
April	46½	49½	47½	49	44	46½	41	44½	43¾	47¼	40	46½	46	48½	1.27½	1.45
May	45½	48	47½	48½	44	46	41	49½	44¼	46	42½	45⅝	46	48½	1.35	1.50
June	44½	55	47½	55	43	52	39	48½	43	54	28¾	34	46½	57	1.35	1.50
July	55	64¾	54	60	32½	57	30	56	51½	58	30½	34½	57	61	1.20	1.35
August	34½	65	31	59	27	31	25	31	33¼	58	27½	30	34¾	60	1.15	1.30
September	32	35	29	32	28½	31½	26⅛	27¼	31½	35	29	31½	36¼	39½	1.17½	1.30
October	33	34½	29½	33½	30	32	27¼	30	32	34	29½	32	38½	41¼	1.15	1.32½
November	34	36	32½	35½	29¾	34	27¾	29½	30½	34	28½	32	41¼	.48	1.20	1.35
December	36	38¼	35½	40	33	39	29¼	32	32½	34	31	32	48½	51	1.25	1.40
1903.																
January	38½	44	....	....	35	39	31¾	34½	33½	36¾	32½	34½	36	38	....	....
February	42½	43¾	....	....	37½	39½	33½	36	36	36¾	34	35½	38	40	....	....
March	42	44½	....	....	37	39	31¼	34⅜	36	36	31	34½	38	39	....	....
April	38	42	....	....	33½	37	32½	35¾	36	36¾	32½	33½	36½	38½	....	....
May	38	39½	....	....	33	37½	33⅜	38¼	36	38	33½	35½	37	39	....	....
June	39¾	43¾	....	....	36	43½	35½	43¼	36½	40½	35	40	39	45	....	....
July	40	43	....	....	31½	41½	33½	45	36½	41	32½	37½	36	41½	....	....
August	38	40½	....	....	33	35¼	33⅝	36¾	37	38½	34	35½	35½	36¾	....	....
September	38	42	....	....	35	39	35½	38	37	40	35¾	38⅜	37½	40	....	....
October	40½	42	....	....	36½	39	34½	38½	37½	39	35	37½	38½	39¾	....	....
November	40	42	....	....	35½	37½	33¼	38½	36½	38½	32⅝	35¼	36½	38½	....	....
December	40½	42½	....	....	37	39	34¼	38	37½	38	34¼	35⅞	37½	39	....	....

Monthly average prices of oats in Chicago.[a]

[Cents per bushel.]

Month.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	29 1/4	31	28 1/4	28 7/8	18 1/4	16 3/8	22 3/4	27	22 3/4	23 7/8	42 3/16	33 1/8
February	29 3/4	30 3/4	28 3/8	28 1/4	19 15/16	16 1/8	25 1/2	27 1/2	23 1/8	24 13/16	42 1/2	34 3/4
March	28 1/2	29 15/16	30 1/16	29 3/8	19 1/4	16 1/2	25 13/16	26 1/2	23 3/4	25 5/8	42 7/8	32 13/16
April	29 1/8	27 15/16	32 1/8	29 1/16	19 1/8	17 1/8	28 7/16	26 13/16	24 1/8	26 1/2	42 3/4	33 15/16
May	31	30 1/2	34 1/2	29 9/16	18 13/16	17 13/16	29	25 7/8	22 1/2	29 7/16	45 1/4	35 13/16
June	31 3/4	29 3/8	42	28 3/16	16 7/8	18 1/8	23 3/4	25 1/4	24	27 7/8	43 3/4	39 3/8
July	31 7/8	26 3/16	38 3/16	23 7/8	16 3/4	17 9/16	23 3/8	22 7/16	23 1/8	33 1/4	43	39 1/4
August	32 5/8	23 1/2	30 7/8	20 7/8	17 1/8	18 3/16	21 3/8	20 5/8	21 13/16	35 1/2	28	35 3/16
September	33 1/8	26 5/16	29 5/16	19 1/4	16	19 13/16	21 5/16	22 1/8	21 11/16	35 3/16	26 11/16	36 3/4
October	30 1/4	27 1/8	28 1/2	18 1/4	18 5/16	18 3/4	23 1/4	22 3/4	22	36 1/8	28 5/8	36 1/2
November	31 1/4	28 1/4	29 1/8	18 1/2	18 5/8	20 7/8	26	23 1/4	22 1/8	40 5/8	28 5/8	35 7/8
December	30 3/4	28 1/8	29 1/2	17 5/16	17 5/8	22 7/16	26 7/8	22 5/8	22 1/4	45 1/8	30 5/8	36 1/8
Yearly average	30 3/4	28 1/4	31 3/4	24 1/4	18 1/16	18 1/4	24 3/4	24 3/8	22 3/4	32	37 1/16	35 13/16

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

BARLEY.

Barley crop of the countries named, 1899–1903.

Country.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	73,382,000	58,926,000	109,933,000	134,954,000	131,861,000
Ontario	15,298,000	17,443,000	17,289,000	22,580,000	25,147,000
Manitoba	5,519,000	3,032,000	6,742,000	12,222,000	8,982,000
Rest of Canada	2,950,000	2,500,000	3,500,000	4,000,000	4,500,000
Total Canada	23,797,000	22,975,000	27,531,000	38,802,000	38,629,000
Mexico	10,735,000	10,529,000	7,727,000	6,045,000	9,000,000
Total North America	107,914,000	92,430,000	145,191,000	179,801,000	179,490,000
Great Britain	68,850,000	64,278,000	63,033,000	68,590,000	61,348,000
Ireland	7,024,000	6,485,000	6,808,000	8,273,000	6,076,000
Total United Kingdom	75,874,000	70,763,000	69,841,000	76,863,000	67,424,000
Sweden	11,691,000	14,786,000	13,368,000	12,988,000	14,653,000
Denmark	21,694,000	22,826,000	22,283,000	23,287,000	23,000,000
Netherlands	3,971,000	4,584,000	3,700,000	4,593,000	4,300,000
Belgium	3,902,000	4,754,000	4,650,000	4,974,000	4,500,000
France	45,306,000	40,847,000	38,857,000	41,948,000	47,358,000
Spain	53,428,000	55,000,000	60,000,000	62,000,000	60,000,000
Italy	8,000,000	7,000,000	8,000,000	6,000,000	8,000,000
Germany	137,048,000	137,889,000	152,537,000	142,392,000	152,653,000
Austria	73,226,000	61,480,000	67,091,000	73,788,000	73,873,000
Hungary	61,587,000	53,877,000	50,071,000	62,350,000	64,577,000
Croatia-Slavonia	2,735,000	2,902,000	3,051,000	3,259,000	3,494,000
Total Austria-Hungary	137,548,000	118,259,000	120,213,000	139,397,000	141,944,000
Roumania	4,543,000	14,618,000	24,222,000	24,671,000	29,716,000
Bulgaria	6,650,000	10,000,000	9,500,000	11,000,000	10,013,000
Russia proper	179,850,000	187,230,000	189,435,000	274,899,000	289,699,000
Poland	20,090,000	18,415,000	20,640,000	22,185,000	20,819,000
North Caucasus	18,144,000	27,105,000	25,685,000	35,530,000	39,980,000
Total Russia in Europe	218,084,000	232,750,000	235,760,000	332,614,000	350,498,000
Total Europe	727,739,000	734,076,000	762,931,000	882,727,000	914,059,000
Siberia	5,955,000	2,969,000	2,003,000	2,628,000	6,972,000
Central Asia	2,870,000	1,262,000	2,154,000	3,008,000	
Total Russia in Asia	8,825,000	4,231,000	4,157,000	5,636,000	6,972,000

Barley crop of the countries named, 1899–1903—Continued.

Country.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Japan	76,855,000	82,697,000	83,352,000	74,321,000	82,000,000
Total Asia	85,680,000	86,928,000	87,509,000	79,957,000	83,972,000
Algeria	33,088,000	35,000,000	35,000,000	47,906,000	46,000,000
Tunis	7,000,000	7,000,000	8,000,000	11,000,000	11,000,000
Cape Colony	857,000	800,000	700,000	800,000	700,000
Total Africa	40,945,000	42,800,000	43,700,000	59,706,000	57,700,000
West Australia	30,000	58,000	30,000	37,000	47,000
South Australia	241,000	195,000	218,000	251,000	327,000
Queensland	36,000	122,000	131,000	286,000	4,000
New South Wales	66,000	138,000	117,000	107,000	18,000
Victoria	1,148,000	1,512,000	1,254,000	716,000	579,000
Tasmania	190,000	70,000	70,000	173,000	103,000
New Zealand	1,731,000	1,635,000	1,060,000	883,000	1,172,000
Total Australasia	3,442,000	3,730,000	2,880,000	2,453,000	2,250,000
Grand total	965,720,000	959,961,000	1,042,211,000	1,204,644,000	1,242,471,000

Visible supply of barley in the United States and Canada first of each month, for ten years.[a]

Month.	1894–1895.	1895–1896.	1896–1897.	1897–1898.	1898–1899.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	383,000	166,000	805,000	1,574,000	587,000
August	200,000	48,000	771,000	1,051,000	584,000
September	774,000	121,000	790,000	1,578,000	548,000
October	2,401,000	1,956,000	2,292,000	2,630,000	2,125,000
November	4,433,000	3,645,000	6,032,000	4,267,000	3,777,000
December	4,455,000	5,674,000	5,500,000	6,318,000	4,406,000
January	3,781,000	4,017,000	4,501,000	5,115,000	4,372,000
February	2,481,000	2,970,000	4,183,000	3,455,000	4,017,000
March	1,974,000	2,081,000	4,124,000	2,571,000	3,067,000
April	1,274,000	1,298,000	3,514,000	1,492,000	2,626,000
May	565,000	1,253,000	2,816,000	1,159,000	1,913,000
June	162,000	957,000	1,819,000	815,000	1,555,000

Month.	1899–1900.	1900–1901.	1901–1902.	1902–1903.	1903–1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	1,059,000	1,038,000	528,000	817,000	602,000
August	694,000	702,000	335,000	217,000	471,000
September	1,055,000	1,158,000	956,000	419,000	1,024,000
October	1,739,000	2,779,000	3,610,000	2,460,000	5,047,000
November	3,925,000	5,396,000	4,813,000	5,064,000	7,313,000
December	4,695,000	6,053,000	5,416,000	5,680,000	7,975,000
January	3,122,000	5,395,000	4,580,000	4,389,000	6,907,000
February	2,303,000	4,331,000	5,211,000	3,843,000	6,338,000
March	2,138,000	3,903,000	5,065,000	3,107,000	5,441,000
April	1,712,000	2,879,000	4,075,000	2,426,000	4,975,000
May	1,720,000	1,761,000	2,146,000	1,493,000	....
June	1,267,000	1,351,000	1,836,000	1,133,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals as reported by Bradstreet's.

Condition of barley crop of United States, monthly, 1888–1903.

Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.
1888	88.8	91.0	89.4	86.9	1896	98.0	88.1	82.9	83.1
1889	95.6	91.9	90.6	88.9	1897	87.4	88.5	87.5	86.4
1890	86.4	88.3	82.8	78.6	1898	78.8	85.7	79.3	79.2
1891	90.3	90.9	93.8	94.3	1899	91.4	92.0	93.6	86.7
1892	92.1	92.0	91.1	87.4	1900	86.2	76.3	71.6	70.7
1893	88.3	88.8	84.6	83.8	1901	98.8	91.3	86.9	85.8
1894	82.2	76.8	69.8	71.5	1902	93.6	93.7	90.2	89.7
1895	90.3	91.9	87.2	87.6	1903	91.5	86.8	83.4	82.1

Acreage, production, value, prices, exports, etc., of barley of the United States, 1866–1903.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866	492,532	22.9	11,283,807	70.2	7,916,342	59	70	85	100	....	3,247,250
1867	1,131,217	22.7	25,727,000	70.1	18,027,746	150	180	227	250	9,810	3,783,966
1868	937,498	24.4	22,896,100	109.0	24,948,127	140	170	149	175	59,077	5,069,880
1869	1,025,795	27.9	28,652,200	70.8	20,298,164	74	85	50	62	255,490	6,727,597
1870	1,108,924	23.7	26,295,400	79.1	20,792,213	68	80	72	95	340,093	4,866,700
1871	1,113,735	24.0	26,718,500	75.8	20,264,015	55½	64	55	71	86,891	5,565,591
1872	1,397,082	19.2	26,846,400	68.6	18,415,839	60	70	71	85	482,410	4,244,751
1873	1,387,106	23.1	32,044,491	86.7	27,794,229	132	158	130	155	320,399	4,891,189
1874	1,580,626	20.6	32,552,500	86.0	27,997,824	120	129½	115	137	91,118	6,255,063
1875	1,789,902	20.6	36,908,600	74.1	27,367,522	81	88	62½	72½	317,781	10,285,957
1876	1,766,511	21.9	38,710,500	63.0	24,402,691	63¾	68½	80	85	1,186,129	6,702,965
1877	1,614,654	21.3	34,441,400	62.8	21,629,130	56¼	64	46½	52½	3,921,501	6,764,228
1878	1,790,400	23.6	42,245,630	57.9	24,454,301	91	100	64	73	715,536	5,720,979
1879	1,680,700	24.0	40,283,100	58.9	23,714,444	86	92	75	80	1,128,923	7,135,258
1880	1,843,329	24.5	45,165,346	66.6	30,090,742	100	120	95	105	885,246	9,528,616
1881	1,967,510	20.9	41,161,330	82.3	33,862,513	101	107	100	100	205,930	12,182,722
1882	2,272,103	21.5	48,953,926	62.9	30,768,015	79	82	80	80	433,005	10,050,687
1883	2,379,009	21.1	50,136,097	58.7	29,420,423	62	67	65	74	724,955	8,596,122
1884	2,608,818	23.5	61,203,000	48.7	29,779,170	53	58	65	65	629,130	9,986,507
1885	2,729,359	21.4	58,360,000	56.3	32,867,696	62	65	58	60	252,183	10,197,115
1886	2,652,957	22.4	59,428,000	53.6	31,840,510	51	54	57	57	1,305,300	10,355,594
1887	2,901,953	19.6	56,812,000	51.9	29,464,390	80	80	69	77	550,884	10,831,461
1888	2,996,382	21.3	63,884,000	59.0	37,672,032	......	......	......	......	1,440,321	11,368,414
1889	3,220,834	24.3	78,332,976	41.6	32,614,271	58	58	......	......	1,408,311	11,332,545
1890	3,135,302	21.4	67,168,344	62.7	42,140,502	......	......	......	......	973,062	5,078,733
1891	3,352,579	25.9	86,839,153	52.4	45,470,342	......	......	......	......	2,800,075	3,146,328
1892	3,400,361	23.6	80,096,762	47.5	38,026,062	65	67	65	65	3,035,267	1,970,129
1893	3,220,371	21.7	69,869,495	41.1	28,729,386	52	54	55	60	5,219,405	791,061
1894	3,170,602	19.4	61,400,465	44.2	27,134,127	53½	55½	51	52	1,563,754	2,116,816
1895	3,299,973	26.4	87,072,744	33.7	29,312,413	33	40	25	36	7,680,331	837,384
1896	2,950,539	23.6	69,695,223	32.3	22,491,241	*a* 22	37	*a* 24½	35	20,030,301	1,271,787
1897	2,719,116	24.5	66,685,127	37.7	25,142,139	*a* 25½	42	*a* 36	53	11,237,077	124,804
1898	2,583,125	21.6	55,792,257	41.3	23,064,359	*a* 40	50½	*a* 36	42	2,267,403	110,475
1899	2,878,229	25.5	73,381,563	40.3	29,594,254	*a* 35	45	*a* 36	44	23,661,662	189,757
1900	2,894,282	20.4	58,925,833	40.8	24,075,271	*a* 37	61	*a* 37	57	6,293,207	171,004
1901	4,295,744	25.6	109,932,924	45.2	49,705,163	*a* 56	63	*a* 64	72	8,714,268	57,406
1902	4,661,063	29.0	134,954,023	45.9	61,898,634	*a* 36	70	*a* 55	62	8,429,141	56,462
1903	4,993,137	26.4	131,861,391	45.6	60,166,313	*a* 59	62½	......	......	....	....

a Chicago prices from 1895 are for No. 3 grade.

Acreage, production, and value of barley in the United States in 1903, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Maine	8,400	29.9	251,160	71	21.23	178,324
New Hampshire	1,601	19.8	31,700	84	16.63	26,628
Vermont	13,472	29.2	393,382	60	17.52	236,029
New York	109,616	26.6	2,915,786	55	14.63	1,603,682
Pennsylvania	8,876	21.3	189,059	56	11.93	105,873
Maryland	1,544	25.9	39,990	50	12.95	19,995
Virginia	2,628	24.4	64,123	57	13.91	36,550
Texas	4,960	24.4	121,024	70	17.08	84,717
Tennessee	1,420	20.6	29,252	65	13.39	19,014
Kentucky	858	21.4	18,361	63	13.48	11,567
Ohio	29,481	23.3	686,977	50	11.65	343,488
Michigan	37,521	25.2	945,529	52	13.10	491,675
Indiana	10,673	22.8	243,344	50	11.40	121,672
Illinois	23,158	28.2	653,056	44	12.41	287,345
Wisconsin	483,537	27.7	13,393,975	48	13.30	6,429,108
Minnesota	1,098,149	25.3	27,783,170	37	9.36	10,279,773
Iowa	482,689	23.4	11,294,923	36	8.42	4,066,172
Missouri	1,820	18.3	33,306	54	9.88	17,985
Kansas	137,550	31.9	4,387,845	34	10.85	1,491,867
Nebraska	64,070	26.6	1,704,262	33	8.78	562,406
South Dakota	339,377	31.4	10,656,438	33	10.36	3,516,625
North Dakota	577,240	21.6	12,468,384	36	7.78	4,488,618
Montana	18,231	40.2	732,886	58	23.32	425,074
Wyoming	1,178	21.3	25,091	72	15.34	18,066
Colorado	18,917	38.3	724,521	61	23.36	441,958
New Mexico	878	23.1	20,282	64	14.78	12,980
Arizona	16,924	32.8	555,107	72	23.62	399,677
Utah	8,381	37.5	314,288	59	22.13	185,430
Nevada	7,166	34.6	247,944	85	29.41	210,752
Idaho	41,881	34.4	1,440,706	52	17.89	749,167
Washington	162,487	37.9	6,158,257	50	18.95	3,079,128
Oregon	61,701	33.2	2,048,473	59	19.59	1,208,599
California	1,201,488	25.7	30,878,242	61	15.68	18,835,728
Oklahoma	15,262	26.9	410,548	44	11.84	180,641
United States	4,993,137	26.4	131,861,391	45.6	12.05	60,166,313

Average yield per acre of barley in the United States, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	26.1	32.4	30.6	25.0	27.0	29.0	27.4	27.5	29.4	29.9
New Hampshire	24.4	25.6	29.3	22.5	23.5	25.0	22.7	21.5	21.2	19.8
Vermont	27.9	33.2	33.0	28.5	30.0	31.0	29.1	29.6	29.7	29.2
Massachusetts	21.7	22.5	30.0	34.5	24.5	30.0	25.8			
Rhode Island	30.0	23.5	29.0	28.0	28.0	29.0	28.0			
New York	17.5	22.9	23.2	25.0	25.2	24.0	22.0	14.0	28.5	26.6
Pennsylvania	16.6	20.2	17.2	24.5	19.4	21.0	19.0	17.2	21.0	21.3
Maryland								18.0	27.0	25.9
Virginia								24.9	18.3	24.4
Texas	15.3	21.6	12.0	25.0	20.0	18.0	24.6	13.5	21.3	24.4
Tennessee	13.8	23.1	14.0	18.0	18.0	11.0	14.7	16.8	16.0	20.6
Kentucky	28.7	33.3	14.8	20.0	16.0	21.0	28.6	19.4	25.9	21.4
Ohio	28.5	28.2	20.2	28.5	28.7	28.0	27.0	24.9	32.3	23.3
Michigan	20.6	18.1	22.3	21.5	25.2	24.0	23.9	22.8	28.6	25.2
Indiana	20.7	15.0	20.3	19.0	23.4	25.0	24.6	25.4	28.0	22.8
Illinois	23.5	20.0	23.7	25.0	27.3	29.0	25.6	24.5	28.6	28.2
Wisconsin	28.6	29.3	27.4	28.0	29.1	30.0	25.5	27.2	33.8	27.7
Minnesota	23.5	36.0	27.2	25.5	28.4	25.0	22.4	25.8	28.6	25.3
Iowa	15.5	28.0	26.3	24.0	26.0	26.0	26.4	23.6	26.3	23.4
Missouri	14.0	15.3	17.5	19.0	20.0	18.0	20.8	16.5	25.0	18.3
Kansas	8.8	14.4	4.6	17.5	28.0	17.0	21.5	15.9	16.0	31.9
Nebraska	5.7	28.4	19.9	22.0	27.1	26.0	17.6	16.0	31.1	26.6
South Dakota	14.7	19.5	28.5	20.0	23.0	23.0	14.3	22.4	29.2	31.4
North Dakota	20.1	30.4	16.1	22.5	26.4	24.0	8.2	28.2	31.6	21.6
Montana	22.5	25.0	25.0	38.0	36.0	35.0	38.8	39.0	37.0	40.2
Wyoming								32.5	24.4	21.3
Colorado	27.8	31.3	20.0	28.0	30.5	28.0	24.8	28.7	26.3	38.3
New Mexico	27.0	28.0	19.0	32.5	33.8	32.0	29.0	31.7	16.1	23.1
Arizona								28.7	25.2	32.8
Utah	33.0	30.0	27.1	31.0	37.0	33.0	36.5	35.0	32.1	37.5
Nevada								33.0	34.3	34.6
Idaho	32.6	24.5	15.3	35.0	35.0	35.0	32.8	40.2	46.3	34.4
Washington	33.7	37.3	26.0	45.0	39.8	35.0	33.4	43.5	43.7	37.9
Oregon	38.6	22.1	21.8	32.5	29.1	28.0	28.9	30.6	31.9	33.2
California	15.2	20.3	21.6	23.0	10.5	26.0	16.7	26.0	26.0	25.7
Oklahoma								22.0	36.0	26.9
General average	19.4	26.4	23.6	24.5	21.6	25.5	20.4	25.6	29.0	26.4

Average yield of barley in certain countries, in bushels per acre, 1894–1902.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(a)	(b)	(b)	(b)	(b)	(a)	(a)
1894	19.4	15.3	33.0	22.3	22.7	22.0	35.9
1895	26.4	13.7	31.2	20.9	21.4	21.9	33.1
1896	23.6	12.8	30.7	19.3	24.0	21.8	35.2
1897	24.5	11.8	29.0	17.6	17.6	19.4	33.9
1898	21.6	14.9	32.2	22.0	23.6	23.3	37.4
1899	25.5	11.1	33.8	24.9	24.0	22.7	35.7
1900	20.4	11.4	33.4	20.2	20.9	21.8	32.7
1901	25.6	11.2	33.3	22.5	20.0	21.1	32.7
1902	29.0	15.6	35.1	24.5	24.1	24.5	36.9
Average	24.0	13.1	32.4	21.6	22.0	22.1	34.8

a Winchester bushels. *b* Bushels of 48 pounds.

Average value per acre of barley in the United States, based upon farm value December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$17.23	$16.85	$13.16	$13.75	$15.12	$17.11	$16.99	$18.43	$19.99	$21.23
New Hampshire	15.37	14.34	15.53	13.50	13.63	16.25	15.21	17.20	15.90	16.63
Vermont	16.74	15.60	13.53	13.11	14.10	16.12	15.13	19.54	18.12	17.52
Massachusetts	13.67	14.63	17.40	22.77	16.17	20.40	17.80	......	......	......
Rhode Island	21.60	17.63	17.40	15.12	17.08	20.30	21.56	......	......	......
New York	9.80	18.55	9.05	10.50	12.10	12.00	11.22	7.84	15.68	14.63
Pennsylvania	7.97	8.28	6.88	9.55	8.54	10.29	9.50	10.15	11.34	11.93
Maryland	......	......	......	......	......	......	......	9.36	13.23	12.95
Virginia	......	......	......	......	......	......	......	11.70	9.88	13.91
Texas	8.41	11.66	6.00	10.75	10.00	11.88	17.71	11.88	15.34	17.08
Tennessee	7.73	11.55	6.30	10.62	10.08	7.04	9.11	11.76	9.76	13.39
Kentucky	13.49	12.65	5.92	8.00	6.40	9.03	15.73	13.77	14.50	13.48
Ohio	13.68	11.56	7.68	11.69	12.63	12.60	11.61	12.70	15.83	11.65
Michigan	10.30	7.78	9.37	8.60	11.00	11.52	11.23	12.31	14.87	13.10
Indiana	9.32	6.00	6.70	8.36	10.30	11.25	11.56	12.95	12.88	11.40
Illinois	11.28	9.00	7.35	9.50	10.65	13.63	12.03	12.99	12.58	12.41
Wisconsin	12.87	9.96	7.40	8.96	11.64	12.00	11.22	13.87	15.55	13.30
Minnesota	9.63	8.64	5.44	6.12	9.37	7.75	8.51	11.61	10.58	9.36
Iowa	6.51	6.44	5.52	5.76	8.84	8.06	9.77	11.09	9.47	8.42
Missouri	7.14	7.34	4.38	7.60	7.20	7.56	9.36	9.08	13.75	9.88
Kansas	4.31	3.31	1.01	4.38	7.56	4.59	7.10	7.15	6.08	10.85
Nebraska	2.45	6.82	3.78	5.28	6.78	7.80	5.81	6.56	10.26	8.78
South Dakota	4.72	3.71	5.42	4.40	6.21	6.67	4.43	9.41	11.10	10.36
North Dakota	7.24	6.08	3.38	6.07	7.66	7.92	2.87	11.28	11.38	7.78
Montana	9.00	14.75	13.75	19.00	20.52	17.85	18.62	22.23	18.87	23.32
Wyoming	......	......	......	......	......	......	......	21.12	18.30	15.34
Colorado	16.04	18.78	9.20	14.28	14.03	15.40	12.40	18.08	15.78	23.36
New Mexico	18.90	19.04	12.35	17.88	18.59	19.52	17.98	20.61	11.43	14.78
Arizona	......	......	......	......	......	......	......	19.52	22.93	23.62
Utah	15.18	11.70	11.38	13.95	17.39	17.16	20.07	18.55	18.91	22.13
Nevada	......	......	......	......	......	......	......	23.10	27.44	29.41
Idaho	15.32	10.29	3.37	14.70	16.80	16.10	16.40	21.31	24.54	17.89
Washington	10.78	14.17	10.40	19.35	17.91	15.40	13.03	17.83	20.10	18.95
Oregon	12.74	8.84	9.81	14.63	14.26	14.00	12.14	14.99	16.59	19.59
California	6.84	8.12	10.37	12.42	6.82	13.00	7.18	10.66	16.38	15.68
Oklahoma	......	......	......	......	......	......	......	10.78	15.12	11.84
General average	8.56	8.88	7.62	9.25	8.93	10.28	8.32	11.57	13.28	12.05

Average farm price of barley per bushel in the United States December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	66	52	43	55	56	59	62	67	68	71
New Hampshire	63	56	53	60	58	65	67	80	75	84
Vermont	60	47	41	46	47	52	52	66	61	60
Massachusetts	63	65	58	66	66	68	69	......	......	......
Rhode Island	72	75	60	54	61	70	77	......	......	......
New York	56	81	39	42	48	50	51	56	55	55
Pennsylvania	48	41	40	39	44	49	50	59	51	56
Maryland	......	......	......	......	......	......	......	52	49	50
Virginia	......	......	......	......	......	......	......	47	54	57
Texas	55	54	50	43	50	66	72	88	72	70
Tennessee	56	50	45	59	56	64	62	70	61	65
Kentucky	47	38	40	40	40	43	55	71	56	63
Ohio	48	41	38	41	44	45	43	51	49	50
Michigan	50	43	42	40	44	48	47	54	52	52
Indiana	45	40	33	44	44	45	47	51	46	50
Illinois	48	45	31	38	39	47	47	53	44	44
Wisconsin	45	34	27	32	40	40	44	51	46	48
Minnesota	41	24	20	24	33	31	38	45	37	37
Iowa	42	23	21	24	34	31	37	47	36	36
Missouri	51	48	25	40	36	42	45	55	55	54
Kansas	49	23	22	25	27	27	33	45	38	34
Nebraska	43	24	19	24	25	30	33	41	33	33
South Dakota	35	19	19	22	27	29	31	42	38	33
North Dakota	36	20	21	27	29	33	35	40	36	36
Montana	40	59	55	50	57	51	48	52	51	58
Wyoming	......	......	......	......	......	......	......	65	75	72
Colorado	58	60	46	51	46	55	50	63	60	61
New Mexico	70	68	65	55	55	61	62	65	71	64
Arizona	......	......	......	......	......	......	......	68	91	72
Utah	46	39	42	45	47	52	55	53	59	59
Nevada	......	......	......	......	......	......	......	70	80	85
Idaho	47	42	22	42	48	46	50	53	53	52
Washington	32	38	40	43	45	41	39	41	46	50
Oregon	33	40	45	45	49	50	42	49	52	59
California	45	40	48	54	65	50	43	41	63	61
Oklahoma	......	......	......	......	......	......	......	49	42	44
General average	44.2	33.7	32.3	37.7	41.3	40.3	40.8	45.2	45.9	45.6

Transportation rates, average for barley in sacks, in cents per 100 pounds, St. Louis to New Orleans, by river.

1883	17.75	1890	15.66	1897	10.83
1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00
1888	15.00	1895	13.00	1902	10.00
1889	17.93	1896	14.54	1903	10.00

Barley as Feed for Horses.

Except on the Pacific coast barley is not extensively used as a feed in the United States, doubtless owing to the fact that it is in such demand for brewing purposes that it is high in price. Wherever it is grown, however, it is frequently possible to secure at a low cost, grain which is off color, owing to rain or fog during harvest, and which, for this or some other reason, is unfit for brewing, but valuable as feed. The barley grown on the Pacific coast is extensively used in the feeding of horses. Its use for this purpose is old in other countries. The Arabs fed their horses unground barley, and it is used successfully by the Berbers of North Africa. In Europe its value is generally recognized. Barley may be fed whole to horses having good teeth and not required to do severe work. Since ground barley, like wheat, forms a pasty mass when mixed with saliva, it is regarded as more satisfactory to crush than to grind it, if for any reason it is considered undesirable to feed the grain whole. In composition, barley resembles oats and other cereal grains quite closely. In a study at the North Dakota Experiment Station of the value of barley as a feed for work horses and mules, it was found that horses did well on barley while the mules, after a time, refused to eat it; but even the horses made better gains on oats than on barley.

Wholesale prices of barley per bushel in leading cities of the United States, 1899–1903.

Date.	New York.		Cincinnati.		Chicago.		San Francisco.	
	Western.		Extra No. 3 spring.		No. 3.		No. 1, brewing (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	57	62	50	56	41	54	$1.40	$1.47½
February	60	62	50	56	41	53	1.40	1.42½
March	53	60	50	53	38	51	1.35	1.42½
April	54	55	50	53	39	48	1.20	1.37½
May	50	54	50	53	36	42	1.17½	1.25
June	46	52	....	....	35½	42	1.02½	1.22½
July	48	50	....	....	34	42	1.05	1.15
August	46	50	....	....	34	43	.97½	1.05
September	50	52	44	50	36	47	.95	1.01¼
October	50	54	50	50	37	46	1.00	1.03¾
November	46	50	48	50	34	45	.96¼	1.01¼
December	49	52	44¾	50	35	45	.85	.97½
1900.								
January	49	50	44¾	49	34	48	.72½	.75
February	50	51	47	49	34	46	.72½	.75
March	52	50	47	49	36	44	.72½	.73¾
April	52	52½	47	49	36	45	.72½	.72½
May	52	52	47	49	36	44	.67½	.72½
June	51	55	....	....	36	48	.67½	.70
July	54	54	....	....	36	48	.70	.71¼
August	52	57	....	....	33	50	.72½	.72½
September	54	58	46	55	38	57	.72½	.72½
October	60	62	56	64	36	59	.71¼	.72½
November	62	65	56	66	36	62	.72½	.75
December	64	66	58	66	37	61	.72½	.75
1901.								
January	65	68	62	70	36	63	.75	.80
February	65	70	62	70	37	61	.73¾	.81¼
March	59	65	62	66	37	59	.75	.82½
April	61	63	60	66	38	58	.78¾	.85
May	63	63	60	64	37	57	.77½	.81¼
June	Nominal.		59	62	40	51	.75	.80
July	57	60	....	....	40	65	.77½	.82½
August	64	67	58	60	48	65	.80	.83¾
September	65	67	65	67	50	62	.80	.82½
October	60	68	62	67	51	60	.77½	.82½
November	62	69	62	66	51	63	.76¾	.82½
December	70	72	68	69	56	63	.78¾	.85
1902.								
January	72	75	67	70	57	65½	.80	.95
February	73	73	67	69	58	64	.90	1.02½
March	73	74	67	70	58	67	.92½	1.02½
April	73	74	68	74	61	70	.93¾	1.02½
May	74	75	67	69	64	72	.95	1.07½
June	Nominal.		67	69	64	71	.92½	1.01¼
July	None.		....	....	48	73	.92½	1.00
August	71	72	....	....	41	65	.93¾	1.01¼
September	65	71	55	65	38	63	.96¼	1.15
October	64	66	55	65	35	60	1.12½	1.25
November	66	66	55	65	35	58	1.18¾	1.30
December	68	68	55	65	36	70	1.22½	1.32½
1903.								
January	....	....	55	65	45	58	....	....
February	....	....	56	65	47	56	....	....
March	....	....	56	65	46	55	....	....
April	....	....	55	62	46	55	....	....
May	....	....	55	62	48	56	....	....
June	....	....	55	62	49	54	....	....
July	....	....	....	....	47	53	....	....
August	....	....	....	....	47	57	....	....
September	....	....	62	71	51	63	....	....
October	....	....	61	69	46	62	....	....
November	....	....	62	69	43	61½	....	....
December	....	....	60	69	42	61½	....	....

RYE.

Rye crop of the countries named, 1899-1903.

Country.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	23,962,000	23,996,000	30,345,000	33,631,000	29,363,000
Ontario	2,357,000	2,432,000	2,625,000	3,620,000	3,064,000
Manitoba	66,000	27,000	64,000	51,000	51,000
Rest of Canada	400,000	375,000	800,000	800,000	800,000
Total Canada	2,823,000	2,834,000	3,489,000	4,471,000	3,915,000
Total North America	26,785,000	26,830,000	33,834,000	38,102,000	33,278,000
Great Britain	....	....	....	....	....
Ireland	....	....	....	....	....
Total United Kingdom	2,000,000	2,000,000	2,000,000	2,000,000	1,800,000
Sweden	21,436,000	26,008,000	22,105,000	23,124,000	24,261,000
Denmark	18,359,000	19,958,000	16,605,000	18,779,000	18,000,000
Netherlands	12,967,000	13,644,000	13,600,000	13,955,000	13,000,000
Belgium	16,544,000	19,854,000	25,045,000	22,374,000	22,000,000
France	66,904,000	59,277,000	58,198,000	47,051,000	60,957,000
Spain	20,519,000	19,000,000	23,000,000	23,000,000	20,000,000
Italy	2,700,000	4,000,000	4,000,000	3,200,000	4,000,000
Germany	341,551,000	336,624,000	321,350,000	373,768,000	389,923,000
Austria	85,268,000	54,792,000	75,514,000	82,482,000	81,158,000
Hungary	47,204,000	40,205,000	40,883,000	49,458,000	47,355,000
Croatia-Slavonia	2,668,000	2,286,000	2,774,000	3,049,000	3,265,000
Total Austria-Hungary	135,140,000	97,283,000	119,171,000	134,989,000	131,778,000
Roumania	1,988,000	5,990,000	9,573,000	6,958,000	7,145,000
Bulgaria	4,655,000	7,000,000	7,000,000	8,000,000	8,000,000
Russia proper	805,230,000	828,816,000	680,205,000	810,537,000	803,362,000
Poland	67,580,000	67,621,000	50,781,000	75,257,000	69,100,000
North Caucasus	7,638,000	7,500,000	7,937,000	8,654,000	7,498,000
Total Russia in Europe	880,448,000	903,937,000	738,923,000	894,448,000	879,960,000
Total Europe	1,525,211,000	1,514,575,000	1,360,570,000	1,571,646,000	1,580,824,000
Siberia	30,523,000	15,853,000	15,620,000	23,080,000	32,048,000
Central Asia	660,000	341,000	382,000	1,489,000	
Total Russia in Asia	31,183,000	16,194,000	16,002,000	24,569,000	32,048,000
Japan [a]	....	....	....	....	....
Grand total	1,583,179,000	1,557,599,000	1,410,406,000	1,634,317,000	1,646,150,000

[a] No rye is raised in Japan. In the Japanese official crop reports occurs the caption *seigle*, the French word for rye, and in previous issues of the Yearbook of this Department the figures under that caption have been taken as indicating the rye crop of Japan. Careful investigation has revealed that the word *seigle* in the Japanese reports was intended to indicate a variety of barley. The figures appearing in former issues of the Yearbook as the rye crop of Japan have therefore in this issue been omitted and have been embodied in another table with the barley crop of Japan.

Influence of Maturity on Rye as Feed.

It was the practice at the Pennsylvania Experiment Station for several years to commence feeding soiling rye about a week before the plants begin to head, and continue until they were too coarse and woody to be relished by the milch cows. This period usually covers from two to three weeks. To measure the rate of increase in dry matter as the plants developed, and to ascertain the yield of dry substance per acre when cut in the early stages of growth, an experiment was undertaken.

It was found that as much digestible dry matter was produced by 1 acre when in blossom as was yielded by 2.34 acres when cut before heading, or twelve days earlier. In five days, covering a period when the plants were heading, there was an increase in digestible dry matter of 67 per cent. In seven days, covering the growth from three-fourths headed to blossom, there was an increase of 39 per cent in digestible dry matter.

Visible supply of rye in the United States and Canada first of each month, for ten years.[a]

Month.	1894-1895.	1895-1896.	1896-1897.	1897-1898.	1898-1899.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	289,000	158,000	1,575,000	2,464,000	988,000
August	263,000	215,000	1,630,000	1,946,000	365,000
September	372,000	511,000	2,328,000	2,499,000	721,000
October	411,000	700,000	2,040,000	3,064,000	894,000
November	556,000	1,250,000	2,596,000	3,832,000	1,260,000
December	508,000	1,702,000	2,695,000	3,932,000	1,212,000
January	583,000	1,739,000	3,276,000	4,436,000	1,573,000
February	508,000	1,763,000	4,266,000	4,291,000	1,576,000
March	423,000	1,710,000	4,104,000	4,099,000	1,724,000
April	366,000	1,631,000	4,128,000	3,682,000	1,658,000
May	182,000	1,481,000	3,607,000	3,039,000	1,335,000
June	177,000	1,467,000	2,798,000	1,526,000	975,000

Month.	1899-1900.	1900-1901.	1901-1902.	1902-1903.	1903-1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	904,000	806,000	747,000	442,000	926,000
August	638,000	725,000	753,000	328,000	867,000
September	647,000	1,056,000	1,864,000	903,000	866,000
October	962,000	1,216,000	2,440,000	1,362,000	1,259,000
November	1,906,000	1,513,000	2,863,000	1,828,000	1,509,000
December	1,892,000	1,754,000	3,463,000	2,159,000	1,744,000
January	1,806,000	1,651,000	3,257,000	2,451,000	1,833,000
February	1,734,000	1,530,000	3,270,000	2,354,000	1,746,000
March	1,951,000	1,532,000	2,972,000	2,273,000	1,717,000
April	1,566,000	1,333,000	2,639,000	1,688,000	1,483,000
May	1,441,000	1,112,000	1,910,000	1,879,000	....
June	1,206,000	938,000	950,000	2,027,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Condition of the rye crop of the United States, monthly, 1886-1903.

Year.	Apr.	May.	June.	July.	Aug.	When harvested.	Year.	Apr.	May.	June.	July.	Aug.	When harvested.
1886	96.6	95.7	94.4	95.6	88.6	93.4	1895	87.0	88.7	85.7	82.2	84.0	83.7
1887	92.0	90.8	88.9	88.0	84.6	82.2	1896	82.9	87.7	85.2	83.8	88.0	82.0
1888	93.5	92.9	93.9	95.1	91.4	92.8	1897	88.9	88.0	89.9	95.0	89.8	90.1
1889	93.9	96.5	95.2	96.7	95.4	91.6	1898	92.1	94.5	97.1	93.8	93.7	89.4
1890	92.8	93.5	92.3	92.0	86.8	85.4	1899	84.9	85.2	84.5	83.3	89.0	82.0
1891	95.4	97.2	95.4	93.9	89.6	95.1	1900	84.8	88.5	87.6	89.6	76.0	84.2
1892	87.0	88.9	91.0	92.9	89.8	88.5	1901	93.1	94.6	93.9	93.5	83.6	84.0
1893	85.7	82.7	84.6	83.8	78.5	82.0	1902	85.4	83.4	88.1	90.3	90.5	90.2
1894	94.4	90.7	93.2	93.9	79.8	86.9	1903	97.9	93.3	90.6	89.2	87.2	84.1

RYE AS BREADSTUFF.

The grain of rye is darker in color than that of wheat, but is otherwise similar in appearance. It differs, however, in one important particular—its gluten has not the same elastic, tenacious quality and does not yield so light and well-raised a loaf. Although this fact and its dark color make it less desirable than wheat flour, it is second in importance as a breadstuff. It is more easily cultivated than wheat, especially in cold countries, and consequently costs less. In many parts of Europe it practically replaces wheat among the poor and in the rations furnished the army. When it is milled entire, as it usually is, it contains more protein than wheat flower, but is probably less completely digested. Wheat and rye flour are often used together in bread.

Acreage, production, value, prices, and exports of rye of the United States, 1866–1903.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	Chicago cash price per bushel, No. 2. December. High.	Chicago cash price per bushel, No. 2. May of following year. Low.	Chicago cash price per bushel, No. 2. May of following year. High.	Domestic exports, including rye flour, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bushels.*
1866	1,548,033	13.5	20,864,944	82.2	17,149,716	......	......	142	150	234,971
1867	1,689,175	13.7	23,184,000	100.4	23,280,584	132	157	173	185	564,901
1868	1,651,321	13.6	22,504,800	94.9	21,349,190	106½	118	100	115½	92,869
1869	1,657,584	13.6	22,527,900	77.0	17,341,861	66	77½	78	83½	199,450
1870	1,176,137	13.2	15,473,600	73.2	11,326,967	67	71	81	91	87,174
1871	1,069,531	14.4	15,365,500	71.1	10,927,623	62	63¾	75	93	832,689
1872	1,048,654	14.2	14,888,600	67.6	10,071,061	57½	70	68½	70	611,749
1873	1,150,355	13.2	15,142,000	70.3	10,638,258	70	81	91	102	1,923,404
1874	1,116,716	13.4	14,990,900	77.4	11,610,339	93	99½	103	107½	267,058
1875	1,359,788	13.0	17,722,100	67.1	11,894,223	67	68¾	61½	70½	589,159
1876	1,468,374	13.9	20,374,800	61.4	12,504,970	65½	73	70	92½	2,234,856
1877	1,412,902	15.0	21,170,100	57.6	12,201,759	55½	56½	54	60	4,249,684
1878	1,622,700	15.9	25,842,790	52.5	13,566,002	44	44½	47	52	4,877,821
1879	1,625,450	14.5	23,639,460	65.6	15,507,431	73½	81	73½	85	2,943,894
1880	1,767,619	13.9	24,540,829	75.6	18,564,560	82	91½	115	118	1,955,155
1881	1,789,100	11.6	20,704,950	93.3	19,327,415	96½	98	77	83	1,003,609
1882	2,227,894	13.4	29,960,037	61.5	18,439,194	57	58½	62	67	2,206,212
1883	2,314,754	12.1	28,058,582	58.1	16,300,503	56½	60	60½	62½	6,247,590
1884	2,343,963	12.2	28,640,000	51.9	14,857,040	51	52	68	73	2,974,390
1885	2,129,301	10.2	21,756,000	57.9	12,594,820	58½	61	58	61	216,699
1886	2,129,918	11.5	24,489,000	53.8	13,181,330	53	54½	54½	56½	377,302
1887	2,053,447	10.1	20,693,000	54.5	11,283,140	55½	61½	63	68	94,827
1888	2,364,805	12.0	28,415,000	58.8	16,721,869	50	52	39	41½	309,266
1889	2,171,493	13.1	28,420,299	42.3	12,009,752	44	45½	49½	54	2,280,975
1890	2,141,853	12.0	25,807,472	62.9	16,229,992	64½	68½	83	92	358,263
1891	2,176,466	14.6	31,751,868	77.4	24,589,217	86	92	70¼	79	12,068,628
1892	2,163,657	12.9	27,978,824	54.2	15,160,056	46	51	50½	62	1,493,924
1893	2,038,485	13.0	26,555,446	51.3	13,612,222	45	47½	44½	48	249,152
1894	1,944,780	13.7	26,727,615	50.1	13,395,476	47½	49	62½	67	32,045
1895	1,890,345	14.4	27,210,070	44.0	11,964,826	32	35¾	33	36½	1,011,128
1896	1,831,201	13.3	24,369,047	40.9	9,960,769	37	42½	32¾	35½	8,575,667
1897	1,703,561	16.1	27,363,324	44.7	12,239,647	45¾	47	48	75	15,562,035
1898	1,643,207	15.6	25,657,522	46.3	11,875,350	52½	55½	56½	62	10,169,822
1899	1,659,308	14.4	23,961,741	51.0	12,214,118	49	52	53	56¼	2,382,012
1900	1,591,362	15.1	23,995,927	51.2	12,295,417	45¾	49¾	51½	54	2,345,512
1901	1,987,505	15.3	30,344,830	55.7	16,909,742	59	65¾	51½	58	2,712,077
1902	1,978,548	17.0	33,630,592	50.8	17,080,793	48	49¾	48½	50½	5,445,273
1903	1,906,894	15.4	29,363,416	54.5	15,993,871	50½	52½	......	......	....

DISTRIBUTION OF SEED GRAIN IN CANADA.

William Saunders, director of the Canada experimental farms, stated in 1903 to a legislative committee that from the farms were sent out 43,901 samples of grain for seed. Great care was taken to have it clean. It was passed through a fanning mill, the best that could be got, so as to have no weeds, and after that there were many thousand pounds picked by hand in order to remove any weed seeds or grain of some other sort that may have got into the sample and which could not be removed in any other way.

Hundreds of letters were received from farmers. Many of them produced sufficient seed for their own sowing and a surplus to sell to their neighbors. That year over 40,000 farmers received samples of grain for this work.

Acreage, production, and value of rye in the United States in 1903, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Vermont	1,924	19.4	37,326	65	12.61	24,262
Massachusetts	4,320	13.7	59,184	73	10.00	43,204
Connecticut	10,570	17.0	179,690	71	12.07	127,580
New York	158,222	15.2	2,404,971	61	9.27	1,467,034
New Jersey	67,929	13.8	937,420	64	8.83	599,949
Pennsylvania	368,367	15.6	5,746,525	62	9.67	3,562,846
Delaware	1,058	14.8	15,658	61	9.03	9,551
Maryland	20,732	13.7	284,028	59	8.08	167,577
Virginia	25,363	12.2	309,429	66	8.05	204,223
North Carolina	20,735	8.8	182,468	84	7.39	153,273
South Carolina	4,269	7.6	32,444	107	8.13	34,715
Georgia	13,778	7.9	108,846	114	9.01	124,084
Alabama	1,622	10.6	17,193	108	11.45	18,568
Texas	3,668	14.2	52,086	74	10.51	38,544
Arkansas	2,481	9.7	24,066	84	8.15	20,215
Tennessee	13,472	13.4	180,525	74	9.92	133,588
West Virginia	10,613	11.5	122,050	71	8.17	86,656
Kentucky	12,872	11.6	149,315	69	8.00	103,027
Ohio	15,275	15.3	233,708	58	8.87	135,551
Michigan	147,524	15.5	2,286,622	51	7.90	1,166,177
Indiana	37,250	12.6	469,350	53	6.68	248,756
Illinois	73,667	16.5	1,215,506	52	8.58	632,063
Wisconsin	315,410	16.6	5,235,806	50	8.30	2,617,903
Minnesota	95,063	18.4	1,749,159	45	8.28	787,122
Iowa	64,818	16.9	1,095,931	44	7.44	482,210
Missouri	21,824	12.8	279,347	55	7.04	153,641
Kansas	82,743	16.2	1,340,437	44	7.13	589,792
Nebraska	156,936	14.2	2,228,491	37	5.25	824,542
South Dakota	34,890	20.2	704,778	40	8.08	281,911
North Dakota	23,338	15.7	366,407	43	6.75	157,555
Montana	1,890	24.6	46,494	63	15.50	29,291
Wyoming	528	18.0	9,504	69	12.42	6,558
Colorado	2,843	18.3	52,027	61	11.16	31,736
Utah	3,738	16.1	60,182	65	10.46	39,118
Idaho	1,208	18.5	22,348	65	12.02	14,526
Washington	2,881	21.0	60,501	72	15.12	43,561
Oregon	11,247	14.2	159,707	97	13.77	154,916
California	68,083	12.3	837,421	77	9.47	644,814
Oklahoma	3,713	17.9	66,463	50	8.95	33,232
United States	1,906,894	15.4	29,363,416	54.5	8.39	15,993,871

DIGESTIBILITY OF DIFFERENT KINDS OF BREAD.

The question is often asked, Which kind of bread furnishes the greatest amount of digestible nutrients? Among the best-known experiments are those of Meyer and Voit, of Munich, about twenty-five years ago. Four kinds of bread were used: (1) Rye bread, raised with a leavening powder; (2) bread made from a mixture of rye and wheat flours and raised with yeast; (3) fine white bread raised with yeast, and (4) coarse whole-wheat bread, which the Germans call "pumpernickel," raised with yeast. The third of these, fine white bread, yielded the highest percentage of digestible nutrients. Next came the wheat and rye bread, then the bread raised with the leavening powder, and last the pumpernickel. The pumpernickel may be left out of account, as it was too coarse to be justly compared with whole-wheat bread such as is made in the United States. The fine wheat bread was the lightest of the other three. Next to it stood the rye and wheat, and last that raised with the powder—the same order that they took with regard to digestibility. These experiments prove, not so much the comparative value of different flours as that the digestibility of bread depends largely upon its lightness.

Average yield per acre of rye in the United States, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	16.5	19.2	18.0	13.5	18.0	15.0	17.2	......	......	......
New Hampshire	15.4	16.0	19.6	18.0	17.5	15.0	17.1	......	......	......
Vermont	13.1	16.0	18.6	16.0	19.1	17.0	16.6	18.3	16.9	19.4
Massachusetts	19.2	19.9	22.0	19.5	16.7	16.0	16.9	15.9	15.2	13.7
Connecticut	12.9	16.9	15.4	19.0	18.0	18.0	17.0	18.0	17.4	17.0
New York	15.4	18.1	14.3	18.5	17.5	16.0	15.1	14.9	17.5	15.2
New Jersey	14.8	13.6	13.8	17.0	15.5	15.0	15.9	15.0	16.4	13.8
Pennsylvania	13.9	15.1	16.0	19.0	16.1	15.0	15.3	15.9	16.0	15.6
Delaware	......	......	......	......	......	......	......	15.3	13.5	14.8
Maryland	13.5	12.9	9.2	17.0	14.5	14.0	16.5	14.4	14.0	13.7
Virginia	8.8	11.0	10.0	11.0	11.2	9.0	10.5	11.1	9.6	12.2
North Carolina	9.0	7.7	7.5	8.8	9.1	7.0	8.9	8.5	8.2	8.8
South Carolina	4.7	9.3	4.8	6.6	8.5	5.0	7.5	7.7	7.6	7.6
Georgia	6.5	7.2	7.1	7.4	8.0	6.0	7.0	7.6	6.3	7.9
Alabama	13.3	10.2	8.0	9.6	11.1	8.0	7.8	8.0	10.0	10.6
Texas	11.3	5.5	7.0	12.0	12.0	10.0	16.5	11.1	9.9	14.2
Arkansas	9.0	10.0	10.0	11.0	11.4	11.0	11.5	8.7	12.3	9.7
Tennessee	7.6	7.2	9.0	10.0	10.5	9.0	11.0	11.3	11.0	13.4
West Virginia	8.0	16.1	10.6	11.5	11.2	10.0	10.5	12.0	8.1	11.5
Kentucky	12.2	13.2	11.0	13.0	13.0	10.0	13.1	14.0	13.4	11.6
Ohio	18.3	14.8	9.6	18.0	17.4	16.0	16.6	16.9	17.5	15.3
Michigan	13.2	13.6	9.2	15.0	15.3	14.0	14.6	14.0	17.9	15.5
Indiana	19.3	12.2	10.6	13.0	15.5	13.0	15.1	14.5	14.5	12.6
Illinois	18.6	15.2	15.3	15.5	14.8	15.0	17.2	17.0	19.1	16.5
Wisconsin	16.0	16.1	14.5	16.0	15.3	15.0	15.8	15.9	18.9	16.6
Minnesota	17.5	21.1	15.6	17.2	20.5	18.0	19.5	19.3	22.3	18.4
Iowa	16.9	20.6	17.5	16.0	19.0	18.0	18.0	18.4	17.4	16.9
Missouri	15.4	12.2	12.2	12.0	13.1	13.0	14.0	14.2	18.2	12.8
Kansas	5.8	5.9	7.0	14.0	15.6	11.0	15.2	14.3	12.0	16.2
Nebraska	6.1	9.3	16.9	17.0	18.8	16.0	14.2	15.0	20.3	14.2
South Dakota	4.5	8.4	11.6	16.5	16.6	15.0	10.6	14.4	18.8	20.2
North Dakota	15.0	21.3	12.0	14.5	15.0	15.0	5.2	13.8	20.2	15.7
Montana								26.7	25.0	24.6
Wyoming	......	......	......	......	......	......	......	24.0	18.0	18.0
Colorado	15.6	14.5	23.5	15.0	18.0	14.0	16.8	16.1	15.9	18.3
Utah	19.0	19.8	20.0	12.0	19.5	17.0	17.5	14.2	12.4	16.1
Idaho	......	......	......	......	......	......	......	15.0	20.2	18.5
Washington	14.4	26.7	15.0	19.5	18.0	16.0	16.3	17.5	17.8	21.0
Oregon	14.1	11.2	12.7	15.0	14.4	11.0	16.1	15.7	13.4	14.2
California	13.2	11.6	14.3	12.2	9.0	15.0	13.0	12.8	12.0	12.3
Oklahoma	......	......	......	......	......	......	......	14.8	16.0	17.9
General average	13.7	14.4	13.3	16.1	15.6	14.4	15.1	15.3	17.0	15.4

Average yield of rye in certain countries, in bushels per acre, 1894–1902.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	Ireland.
	(a)	(b)	(b)	(b)	(b)	(a)	(b)
1894	13.7	12.7	22.0	17.2	19.5	19.5	25.4
1895	14.4	11.6	20.9	14.5	16.7	18.8	26.8
1896	13.3	10.9	22.7	16.3	18.2	18.7	25.4
1897	16.1	9.3	21.8	13.9	13.5	13.4	21.6
1898	15.6	10.5	24.2	17.7	16.9	18.3	25.8
1899	14.4	12.8	23.6	18.7	17.7	18.2	25.8
1900	15.1	12.5	22.9	13.0	15.1	16.9	25.6
1901	15.3	14.0	22.4	16.9	15.8	16.7	27.4
1902	17.0	12.4	24.5	18.2	19.3	14.3	28.0
Average	15.0	11.6	22.8	16.3	17.0	17.2	25.8

a Winchester bushels. b Bushels of 56 pounds.

Average value per acre of rye in the United States, based upon farm value December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$13.37	$16.32	$12.06	$11.07	$15.12	$12.60	$14.10	......	......	......
New Hampshire	11.40	12.16	14.11	15.12	13.12	12.15	14.02	......	......	......
Vermont	9.56	9.12	12.09	9.60	11.08	10.54	10.13	$14.64	$13.01	$12.61
Massachusetts	14.02	13.33	15.40	11.90	10.52	12.64	12.68	12.56	12.16	10.00
Connecticut	8.39	10.65	8.78	11.21	10.80	11.52	11.05	12.96	13.05	12.07
New York	8.32	8.69	6.29	8.88	8.75	8.96	8.46	9.24	10.15	9.27
New Jersey	8.14	6.94	6.49	8.50	7.75	8.25	8.74	8.85	10.00	8.83
Pennsylvania	7.78	7.55	7.52	8.17	7.57	7.65	8.11	9.54	8.48	9.67
Delaware	......	......	......	......	......	......	......	8.87	8.37	9.03
Maryland	6.35	6.32	4.42	7.82	7.83	7.98	8.58	8.06	8.12	8.08
Virginia	4.75	5.72	4.80	5.50	5.15	4.77	6.09	6.77	6.54	8.05
North Carolina	6.30	4.93	5.32	5.28	5.82	5.25	6.76	6.63	6.97	7.39
South Carolina	4.51	10.70	4.18	5.68	8.67	5.45	7.87	8.55	8.59	8.13
Georgia	6.31	6.12	7.17	6.81	7.84	6.72	7.21	8.06	6.93	9.01
Alabama	12.64	8.57	7.04	11.33	11.65	8.32	8.03	8.32	10.50	11.45
Texas	8.48	4.13	4.69	8.64	8.52	8.20	11.05	10.32	7.52	10.51
Arkansas	6.84	6.20	7.00	9.46	7.41	8.14	8.28	7.74	8.98	8.15
Tennessee	4.48	4.46	5.40	5.80	5.56	6.03	7.48	8.36	8.03	9.92
West Virginia	4.56	9.82	5.94	5.87	5.82	6.20	6.72	7.80	5.51	8.17
Kentucky	7.20	7.39	5.94	6.89	7.15	7.00	8.25	9.38	8.31	8.00
Ohio	8.23	6.66	3.74	7.92	7.83	8.80	9.13	9.30	9.27	8.87
Michigan	6.07	5.44	2.94	6.30	6.58	7.28	7.01	7.28	8.77	7.90
Indiana	8.11	5.12	3.82	5.46	6.67	6.24	7.55	7.68	6.67	6.68
Illinois	8.00	6.08	5.20	6.82	6.51	7.05	8.08	9.69	9.55	8.58
Wisconsin	6.88	5.64	4.82	6.56	6.58	7.20	7.74	8.27	9.45	8.30
Minnesota	7.53	5.91	4.68	6.36	7.79	7.56	8.19	9.46	9.59	8.28
Iowa	7.77	6.39	5.08	5.76	7.60	7.20	7.38	9.20	7.31	7.44
Missouri	7.24	4.76	5.73	5.28	6.16	6.50	7.14	9.51	8.74	7.04
Kansas	2.67	2.24	2.45	5.60	5.77	4.62	6.54	7.87	5.40	7.13
Nebraska	2.93	2.79	3.72	5.44	6.39	6.08	5.68	6.90	7.31	5.25
South Dakota	2.07	2.10	3.13	5.78	5.64	5.55	4.13	6.19	7.71	8.08
North Dakota	5.55	5.75	2.64	5.22	5.40	5.55	2.13	5.93	8.69	6.75
Montana	......	......	......	......	......	......	......	16.02	16.00	15.50
Wyoming	......	......	......	......	......	......	......	19.20	9.00	12.42
Colorado	10.30	6.96	14.57	7.80	9.00	6.72	9.07	9.98	8.90	11.16
Utah	10.83	6.93	8.00	7.20	8.97	8.16	9.10	9.23	7.56	10.46
Idaho	......	......	......	......	......	......	......	10.05	12.12	12.02
Washington	8.06	20.03	7.50	12.09	10.44	9.60	9.45	10.85	11.39	15.12
Oregon	8.04	6.05	7.62	8.85	10.37	7.70	9.82	10.36	9.78	13.77
California	7.92	6.73	8.70	7.93	6.30	11.70	7.54	7.30	9.00	9.47
Oklahoma	......	......	......	......	......	......	......	10.36	7.52	8.95
General average	6.89	6.33	5.44	7.18	7.23	7.36	7.73	8.51	8.63	8.39

Average farm price of rye per bushel in the United States December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	81	85	67	82	84	84	82	......	......	......
New Hampshire	74	76	72	84	75	81	82	......	......	......
Vermont	73	57	65	60	58	62	61	80	70	65
Massachusetts	73	67	70	61	63	79	75	79	80	73
Connecticut	65	63	57	59	60	64	65	72	75	71
New York	54	48	44	48	50	56	56	62	58	61
New Jersey	55	51	47	50	50	55	55	59	61	64
Pennsylvania	56	50	47	43	47	51	53	60	53	62
Delaware	......	......	......	......	......	......	......	58	62	61
Maryland	47	49	48	46	54	57	52	56	58	59
Virginia	54	52	48	50	46	53	58	61	66	66
North Carolina	70	64	71	60	64	75	76	78	85	84
South Carolina	96	115	87	86	102	109	105	111	113	107
Georgia	97	85	101	92	98	112	103	106	110	114
Alabama	95	84	88	118	105	104	103	104	105	108
Texas	75	75	67	72	71	82	67	93	76	74
Arkansas	76	72	70	86	65	74	72	89	73	84
Tennessee	59	62	60	58	53	67	68	74	73	74
West Virginia	57	61	56	51	52	62	64	65	68	71
Kentucky	59	56	54	53	55	70	63	67	62	69
Ohio	45	45	39	44	45	55	55	55	53	58
Michigan	46	40	32	42	43	52	48	52	49	51
Indiana	42	42	36	42	43	48	50	53	46	53
Illinois	43	40	34	44	44	47	47	57	50	52
Wisconsin	43	35	33	41	43	48	49	52	50	50
Minnesota	43	28	30	37	38	42	42	49	43	45
Iowa	46	31	29	36	40	40	41	50	42	44
Missouri	47	39	47	44	47	50	51	67	48	55
Kansas	46	38	35	40	37	42	43	55	45	44
Nebraska	48	30	22	32	34	38	40	46	36	37
South Dakota	46	25	27	35	34	37	39	43	41	40
North Dakota	37	27	22	36	36	37	41	43	43	43
Montana	......	......	......	......	......	......	......	60	64	63
Wyoming	......	......	......	......	......	......	......	80	50	69
Colorado	66	48	62	52	50	48	54	62	56	61
Utah	57	35	40	60	46	48	52	65	61	65
Idaho	......	......	......	......	......	......	......	67	60	65
Washington	56	75	50	62	58	60	58	62	64	72
Oregon	57	54	60	59	72	70	61	66	73	97
California	60	58	60	65	70	78	58	57	75	77
Oklahoma	......	......	......	......	......	......	......	70	47	50
General average	50.1	41.0	40.9	44.7	46.3	51.0	51.2	55.7	50.8	51.5

Transportation rates, average for rye in sacks, in cents per 100 pounds, St. Louis to New Orleans, by river.

1883	17.75	1890	15.66	1897	10.83
1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00
1888	15.00	1895	13.00	1902	10.00
1889	17.93	1896	14.54	1903	10.00

Wholesale prices of rye per bushel in leading cities of the United States, 1899–1903.

Date.	New York. Prime State. Low.	New York. Prime State. High.	Cincinnati. No. 2. Low.	Cincinnati. No. 2. High.	Chicago. No. 2. Low.	Chicago. No. 2. High.	Duluth. Low.	Duluth. High.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1899.								
January	63¾	67½	57	65	53½	58¾	53	58
February	61½	68	60	65	51	56¼	54½	56
March	63	67½	59	65	49¼	56½	48½	55¾
April	63	68½	60	65	52	59	50½	58
May	65	67	62	68	56½	62	56	58½
June	64	66½	64	68	56	62	56	59½
July	60	65½	57	67	51	60	50	58
August	59	61¾	56	60	51½	56½	50½	53½
September	61½	66	58	65	54	58	52¾	57½
October	61	63	61½	65½	54¼	58	53	57¼
November	56	62	59	64	49	53	48	52
December	58½	61½	60	65½	49	52	47	49½
1900.								
January	60	61¼	59	64	50	52	48½	50
February	60½	64½	61	65	51	55½	50	53
March	60½	63½	60	64	52½	55	51	53½
April	60½	63½	60	63½	53	55½	51½	52½
May	60¼	62½	61	63½	53	56¼	51¾	53¾
June	61½	68	61	67	52¾	60½	52½	60½
July	57	65	59	66	50	58	49	57½
August	54½	58	51½	60	48	51½	48	50½
September	56¾	60½	53	57	50¼	53½	50	53½
October	56	61	55	59	47¼	52¼	48	53
November	54	56	52	56	41½	48	46	48¾
December	54	56	52	55½	45¾	49¾	46¼	48½
1901.								
January	57	59	53	58½	47½	49¾	48	50
February	59½	61	56	59	48½	50¼	49¼	50½
March	60½	61	55	59	49½	51½	50¼	51¼
April	58½	60½	54	58½	48¾	53	49¾	53
May	59	61¾	57	62	51½	54	51	53
June	55	59½	55	61	46¾	53	46½	51½
July	51½	61	45	55½	47	57	46½	53½
August	59	61	52½	64	52	60	50	57¼
September	59	62	56½	60	52½	56	50	57¼
October	58	62½	56½	59½	53¼	56	50½	52½
November	63	68	57	65½	54½	61	52½	57¼
December	68½	72½	64½	73	59	65¾	57½	62½
1902.								
January	68	74	66	71½	56	67½	54	64
February	68	70	64	67	56	60½	53	57½
March	63	69	63	65	54½	58	52	54½
April	63	66	62	64	54½	57½	52	56
May	65	67	60	63½	54½	58	54	57
June	65	66¼	54	59	56¾	58	55¼	56½
July	65½	66½	55½	58	52¼	61½	51¼	58
August	57½	66	51	56	48	54	46	51
September	57	59¼	52½	55½	49	50½	47½	49
October	57	58⅜	52	53	48	50½	47	49
November	58	59	51	54	48½	51½	49	49¾
December	57½	59½	51	56	48	49¾	48	49¾
1903.								
January	....	....	55½	59	48	50¼	48	49
February	....	....	57½	58½	48¾	51½	48	49
March	....	....	56	58½	48¾	51½	49	49½
April	....	....	55	58	48	51	49	50½
May	....	....	54	58	48	50½	49½	50
June	....	....	57	58	49	53¾	50	52
July	....	....	56	57½	49½	51½	48½	50½
August	....	....	55	60	50½	53½	50½	52½
September	....	....	59½	63	53	60	50½	55¼
October	....	....	61	63	53	56½	52	54
November	....	....	58	62	51½	58¼	52	54
December	....	....	59	62½	50½	52½	51	52½

Monthly average prices of rye in Chicago. [a]

[Cents per bushel.]

Month.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	82 5/8	54	44 3/4	49 1/4	36 7/8	36	46 1/8	56 1/8	51	48 5/8	61 3/4	49 1/8
February	83	52	45	51 1/2	39 1/2	34	48 5/8	55 1/8	53 1/4	49 3/8	58 1/4	50 1/8
March	80 1/2	49 1/2	47 1/4	52 1/2	37 5/8	33 1/4	49 5/8	52 3/4	53 3/4	50 1/2	56 1/4	50 1/8
April	73 1/4	49 1/2	48	60	36 1/4	33 3/4	56	55 1/2	54 1/4	50 7/8	56	49 1/2
May	74 1/2	57	46 1/2	64 3/4	34 3/4	34 1/8	61 1/2	59 1/4	54 5/8	52 3/4	56 1/4	49 1/2
June	77	50 1/4	47 1/2	63 3/4	31 1/4	33 3/4	45	59	57 3/8	49 7/8	57 3/8	51 3/8
July	70	47	44	51	30 3/8	37 3/4	45 5/8	55 1/2	54	52	56 7/8	50 1/4
August	62	45	45 3/4	42	30	48 1/2	43 3/4	54	49 3/4	56	51	52
September	56 3/4	43 1/2	47 1/4	39	33 3/8	49 1/2	45 3/4	56	51 7/8	54 1/4	49 3/4	56 1/2
October	52	45	47	39	37 1/2	46	48	56 1/8	49 3/4	54 5/8	49 1/4	51 1/4
November	50	45 1/2	47 1/4	36 1/2	39 1/2	46 1/2	51 1/8	51	46 1/4	57 3/4	50	51 7/8
December	49 1/4	46 1/2	48 7/8	34	39 3/4	46 3/8	54	50 1/2	47 5/8	62 3/8	48 7/8	51 1/2
Yearly average	67 9/16	48 3/4	46 9/16	48 5/8	35 9/16	40	49 1/2	55 1/16	52	53 1/4	54 5/16	51 5/8

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

BUCKWHEAT.

Condition of buckwheat crop of United States, monthly, 1887–1903

Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.
1887	93.3	89.1	76.6	1892.	92.9	89.0	85.6	1896.	96.0	93.2	86.0	1900.	87.9	80.5	72.8
1888	92.5	93.7	79.1	1893.	88.8	77.5	73.5	1897.	94.9	95.1	90.8	1901.	91.1	90.9	90.5
1889	95.2	92.1	90.0	1894.	82.3	69.2	72.0	1898.	87.2	88.8	76.2	1902.	91.4	86.4	80.5
1890	90.1	90.5	90.7	1895.	85.2	87.5	81.8	1899.	93.2	75.2	70.2	1903.	93.9	91.0	83.0
1891	97.3	96.6	92.7												

Acreage, production, value, and price of buckwheat in the United States, 1866–1903.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1866	1,045,624	21.8	22,791,839	67.6	15,413,160
1867	1,227,826	17.4	21,359,000	78.7	16,812,070
1868	1,113,993	17.8	19,863,700	78.0	15,490,426
1869	1,028,693	16.9	17,431,100	71.9	12,534,851
1870	536,992	18.3	9,841,500	70.5	6,937,471
1871	413,915	20.1	8,328,700	74.5	6,208,165
1872	448,497	18.1	8,133,500	73.5	5,979,222
1873	454,152	17.3	7,837,700	75.0	5,878,629
1874	452,590	17.7	8,016,600	72.9	5,843,645
1875	575,530	17.5	10,082,100	62.0	6,254,564
1876	666,441	14.5	9,668,800	66.6	6,435,836
1877	649,923	15.7	10,177,000	66.9	6,808,180
1878	673,100	18.2	12,246,820	52.6	6,441,240
1879	639,900	20.5	13,140,000	59.8	7,856,191
1880	822,802	17.8	14,617,535	59.4	8,682,488
1881	828,815	11.4	9,486,200	86.5	8,205,705
1882	847,112	13.0	11,019,353	73.0	8,038,862
1883	857,349	8.9	7,668,954	82.2	6,303,980
1884	879,403	12.6	11,116,000	58.9	6,549,020
1885	914,394	13.8	12,626,000	55.9	7,057,363
1886	917,915	12.9	11,869,000	54.5	6,465,120
1887	910,506	11.9	10,844,000	56.5	6,122,320
1888	912,630	13.2	12,050,000	63.3	7,627,647
1889	837,162	14.5	12,110,329	50.5	6,113,119
1890	844,579	14.7	12,432,831	57.4	7,132,872
1891	849,364	15.0	12,760,932	57.0	7,271,506
1892	861,451	14.1	12,143,185	51.8	6,295,643
1893	815,614	14.9	12,122,311	58.4	7,074,450
1894	789,232	16.1	12,668,200	55.6	7,040,238
1895	763,277	20.1	15,341,399	45.2	6,936,325
1896	754,898	18.7	14,089,783	39.2	5,522,339
1897	717,836	20.9	14,997,451	42.1	6,319,188
1898	678,332	17.3	11,721,927	45.0	5,271,462
1899	670,148	16.6	11,094,473	55.7	6,183,675
1900	637,930	15.0	9,566,966	55.8	5,341,413
1901	811,164	18.6	15,125,939	56.3	8,523,317
1902	804,889	18.1	14,529,770	59.6	8,654,704
1903	804,393	17.7	14,243,644	60.7	8,650,733

Acreage, production, and value of buckwheat in the United States in 1903, by States.

State.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Maine	24,459	29.8	728,878	51	15.20	371,728
New Hampshire	1,972	19.6	38,651	59	11.56	22,804
Vermont	9,320	24.0	223,680	55	13.20	123,024
Massachusetts	2,180	13.7	29,866	68	9.32	20,309
Connecticut	3,673	17.5	64,278	71	12.42	45,637
New York	338,365	18.3	6,192,080	59	10.80	3,653,327
New Jersey	13,270	18.1	240,187	64	11.58	153,720
Pennsylvania	252,195	16.5	4,161,218	64	10.56	2,663,180
Delaware	1,460	15.2	22,192	55	8.36	12,206
Maryland	8,374	16.3	136,496	63	10.27	85,992
Virginia	19,610	18.6	364,746	61	11.35	222,495
North Carolina	5,607	12.1	67,845	65	7.86	44,099
Tennessee	635	14.7	9,334	66	9.70	6,160
West Virginia	21,344	17.2	367,117	68	11.70	249,640
Ohio	9,089	16.6	150,877	65	10.79	98,070
Michigan	36,548	15.5	566,494	54	8.37	305,907
Indiana	5,335	16.8	89,628	70	11.76	62,740
Illinois	5,082	15.3	77,755	73	11.17	56,761
Wisconsin	25,671	15.6	400,468	61	9.52	244,285
Minnesota	4,874	15.2	74,085	53	8.06	39,265
Iowa	8,906	15.1	134,481	71	10.72	95,482
Missouri	2,289	14.8	33,877	75	11.10	25,408
Kansas	1,921	18.4	35,346	78	14.35	27,570
Nebraska	944	19.0	17,936	69	13.11	12,376
North Dakota	1,270	12.7	16,129	53	6.73	8,548
United States	804,393	17.7	14,243,644	60.7	10.75	8,650,733

Average yield per acre of buckwheat in the United States, 1894–1903, by States.

State.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	37.8	38.6	42.3	35.0	26.5	22.0	30.0	31.7	30.4	29.8
New Hampshire	20.0	29.9	27.2	27.0	20.0	20.0	22.0	21.0	20.0	19.6
Vermont	22.4	34.5	31.4	24.0	21.4	23.0	25.0	25.1	25.0	21.0
Massachusetts	18.9	15.0	18.3	19.0	20.0	20.0	17.0	18.9	14.4	13.7
Connecticut	16.4	15.4	14.2	17.0	19.0	19.0	16.0	18.0	18.4	17.5
New York	15.5	21.4	18.8	22.0	16.8	13.0	14.0	18.8	17.7	18.3
New Jersey	14.4	18.7	20.7	16.0	21.0	21.0	16.0	19.0	22.5	18.1
Pennsylvania	18.0	19.9	17.3	21.0	17.2	20.0	14.0	19.5	18.1	16.5
Delaware	20.0	10.0	20.0	19.0	16.5	18.0	13.0	17.8	15.2	15.2
Maryland	20.0	10.9	22.7	19.0	12.2	13.0	15.0	17.5	17.0	16.3
Virginia	14.7	10.1	18.0	14.0	17.3	14.0	13.0	15.9	16.6	18.6
North Carolina	18.7	12.0	20.0	11.0	19.5	17.0	13.0	15.6	14.5	12.1
Tennessee	12.8	10.0	24.0	18.0	18.0	12.0	14.0	14.2	18.0	14.7
West Virginia	22.6	18.8	19.5	19.0	20.5	17.0	17.0	20.6	22.5	17.2
Ohio	14.9	14.6	18.8	18.0	20.0	16.0	16.0	16.1	13.9	16.6
Michigan	12.0	17.2	15.3	17.0	14.2	11.0	14.0	14.1	13.0	15.5
Indiana	14.8	14.3	24.0	14.0	18.4	16.0	14.0	13.1	17.6	16.8
Illinois	11.7	13.3	13.8	13.0	14.0	15.0	15.0	11.0	15.5	15.3
Wisconsin	8.5	17.9	13.5	18.0	15.5	15.0	14.0	12.4	16.0	15.6
Minnesota	9.2	15.3	10.6	17.0	15.0	17.0	15.0	14.5	13.9	15.2
Iowa	13.6	13.5	16.2	17.0	16.0	16.0	15.0	13.5	16.0	15.1
Missouri	9.2	10.2	21.8	15.0	15.8	14.0	13.0	6.0	16.0	14.8
Kansas	......	......	......	......	......	......	......	7.9	12.0	18.4
Nebraska	3.7	6.7	21.3	14.0	12.8	16.0	16.0	11.5	14.7	19.0
North Dakota	......	......	......	......	......	......	......	11.5	10.0	12.7
Oregon	38.0	15.5	21.0	18.0	14.0	17.0	13.0	......	......	......
General average	16.0	20.1	18.7	20.9	17.3	16.6	15.0	18.6	18.1	17.7

Average value per acre of buckwheat in the United States, based upon farm value December 1, 1894–1903, by States.

State.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$21.92	$17.76	$16.07	$15.40	$10.34	$9.68	$14.70	$15.22	$15.81	$15.20
New Hampshire	12.20	14.05	17.20	14.85	9.40	10.00	11.44	11.55	13.00	11.56
Vermont	12.77	12.77	12.56	11.04	9.84	11.96	12.50	14.81	14.00	13.20
Massachusetts	12.85	8.85	9.70	12.54	12.20	14.00	12.24	11.53	10.66	9.32
Connecticut	10.99	8.62	7.24	9.69	10.64	11.97	10.40	11.70	13.06	12.42
New York	8.37	9.42	6.96	8.80	7.56	7.67	7.98	10.72	10.44	10.80
New Jersey	9.36	9.35	8.07	7.84	11.34	11.76	9.44	9.88	14.40	11.58
Pennsylvania	9.54	8.76	6.57	8.82	7.57	10.80	7.70	10.92	11.04	10.56
Delaware	10.00	5.00	6.00	6.84	6.60	8.82	6.76	9.79	9.12	8.36
Maryland	11.20	6.10	11.12	9.69	6.47	7.28	8.55	10.50	10.37	10.27
Virginia	7.94	5.45	8.46	7.00	7.79	7.56	7.15	8.90	9.96	11.35
North Carolina	8.79	5.28	12.00	5.39	9.36	8.33	7.28	9.67	8.99	7.86
Tennessee	7.30	5.40	14.88	10.26	9.36	6.84	8.26	8.38	13.68	9.70
West Virginia	14.01	10.72	9.75	9.31	10.05	9.52	9.52	12.15	13.95	11.70
Ohio	9.83	8.03	8.08	9.00	10.20	9.28	9.28	9.66	8.48	10.79
Michigan	6.60	7.40	5.81	6.46	5.96	6.05	7.14	7.19	6.89	8.37
Indiana	8.29	8.29	12.24	6.86	9.38	9.44	8.54	7.99	10.21	11.76
Illinois	9.01	5.85	6.21	7.41	7.28	8.70	9.75	7.70	11.01	11.17
Wisconsin	4.76	8.23	5.13	6.84	6.20	9.45	8.26	7.32	9.44	9.52
Minnesota	5.43	7.80	4.35	7.65	7.35	8.84	8.55	8.99	7.92	8.06
Iowa	10.20	6.75	7.45	8.33	7.69	9.28	9.60	9.45	11.20	10.72
Missouri	5.52	5.92	15.26	9.00	9.48	8.54	8.97	4.56	9.34	11.10
Kansas	......	......	......	......	......	......	......	5.92	9.00	14.35
Nebraska	2.52	4.36	10.65	7.14	7.81	9.92	10.24	6.67	7.79	13.11
North Dakota	......	......	......	......	......	......	......	6.90	5.40	6.73
Oregon	20.90	7.75	14.28	9.90	8.12	12.58	10.01	......	......	......
General average	8.92	9.09	7.32	8.80	7.77	9.23	8.37	10.51	10.75	10.75

Average farm price of buckwheat per bushel in the United States, December 1, 1894–1903, by States.

State.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	58	46	38	44	39	44	49	48	52	51
New Hampshire	61	47	63	55	47	50	52	55	65	59
Vermont	57	37	40	46	46	52	50	59	56	55
Massachusetts	68	59	53	66	61	70	72	61	74	68
Connecticut	67	56	51	57	56	63	65	65	71	71
New York	54	44	37	40	45	59	57	57	59	59
New Jersey	65	50	39	49	54	56	59	52	64	64
Pennsylvania	53	44	38	42	44	54	55	56	61	64
Delaware	50	50	30	36	40	49	52	55	60	55
Maryland	56	56	49	51	53	56	57	60	61	63
Virginia	54	54	47	50	45	54	55	56	60	61
North Carolina	47	44	60	49	48	49	56	62	62	65
Tennessee	57	54	62	57	52	57	59	59	76	66
West Virginia	62	57	50	49	49	56	56	59	62	68
Ohio	66	55	43	50	51	58	58	60	61	65
Michigan	55	43	38	38	42	55	51	51	53	54
Indiana	56	58	51	49	51	59	61	61	58	70
Illinois	77	44	45	57	52	58	65	70	71	73
Wisconsin	56	46	38	38	40	63	59	59	59	61
Minnesota	59	51	41	45	49	52	57	62	57	53
Iowa	75	50	46	49	48	58	64	70	70	71
Missouri	60	58	70	60	60	61	69	76	58	75
Kansas	......	......	......	......	......	......	......	75	75	78
Nebraska	68	65	50	51	61	62	64	58	53	69
North Dakota	......	......	......	......	......	......	......	60	54	53
Oregon	55	50	68	55	58	74	77	......	......	......
General average	55.6	45.2	39.2	42.1	45.0	55.7	55.8	56.3	59.6	60.7

POTATOES.

Condition of the potato crop of the United States, monthly, 1888–1903.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
1888	95.7	93.2	91.6	86.8	1896	99.0	94.8	83.2	81.7
1889	95.1	94.3	81.7	77.9	1897	87.8	77.9	66.7	61.6
1890	91.7	77.4	65.7	61.7	1898	95.5	83.9	77.7	72.5
1891	95.3	96.5	94.8	91.3	1899	93.8	93.0	86.3	81.7
1892	90.0	86.8	74.8	67.7	1900	91.3	88.2	80.0	74.4
1893	94.8	86.0	71.8	71.2	1901	87.4	62.3	52.2	54.0
1894	92.3	74.0	62.4	64.3	1902	92.9	94.8	89.1	82.5
1895	91.5	89.7	90.8	87.4	1903	88.1	87.2	84.3	74.6

Acreage, production, value, prices, exports, etc., of potatoes of the United States, 1866–1903.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago price per bushel, Burbank. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports during fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866	1,069,381	100.2	107,200,976	47.3	50,722,553					512,380	198,265
1867	1,192,195	82.0	97,783,000	65.9	64,462,486					378,605	209,555
1868	1,131,552	93.8	106,090,000	59.3	62,918,660					508,249	138,470
1869	1,222,250	109.5	133,886,000	42.9	57,481,362					596,968	75,336
1870	1,325,119	86.6	114,775,000	65.0	74,621,019					553,070	458,758
1871	1,220,912	98.7	120,461,700	53.9	64,905,189					621,537	96,259
1872	1,331,331	85.3	113,516,000	53.5	60,692,129					515,306	346,840
1873	1,295,139	81.9	106,089,000	65.2	69,153,709					497,413	549,073
1874	1,310,041	80.9	105,981,000	61.5	65,223,314					609,642	188,757
1875	1,510,041	110.5	166,877,000	34.4	57,357,515					704,379	92,148
1876	1,741,983	71.7	124,827,000	61.9	77,319,541					529,650	3,205,555
1877	1,792,287	94.9	170,092,000	43.7	74,272,500					744,409	528,584
1878	1,776,800	69.9	124,126,650	58.7	72,923,575					625,342	2,624,149
1879	1,836,800	98.9	181,626,400	43.6	79,153,673					696,080	721,868
1880	1,842,510	91.0	167,659,570	48.3	81,062,214					638,840	2,170,372
1881	2,041,670	53.5	109,145,494	91.0	99,291,341					408,286	8,789,860
1882	2,171,636	78.7	170,972,508	55.7	95,304,844					439,443	2,362,362
1883	2,289,275	90.9	208,164,425	42.2	87,849,991					554,613	425,408
1884	2,220,980	85.8	190,642,000	39.6	75,524,290					380,868	658,633
1885	2,265,823	77.2	175,029,000	44.7	78,153,403			33	50	494,948	1,937,416
1886	2,287,136	73.5	168,051,000	46.7	78,441,940	44	47	65	90	434,864	1,432,490
1887	2,357,322	56.9	134,103,000	68.2	91,506,740	70	83	65	85	403,880	8,259,538
1888	2,533,280	79.9	202,365,000	40.2	81,413,589	30	37	24	45	471,955	883,380
1889	2,647,989	77.4	204,881,441	35.4	72,610,934	33	45	30	60	406,618	3,415,578
1890	2,651,579	55.9	148,289,696	75.8	112,341,708	82	93	95	110	341,189	5,401,912
1891	2,714,770	93.7	254,423,607	35.8	91,012,962	30	40	30	50	557,022	186,871
1892	2,547,962	61.5	156,654,819	66.1	103,567,520	60	72	70	98	845,720	4,317,021
1893	2,605,186	70.3	183,034,203	59.4	108,661,801	51	60	64	88	893,111	3,002,578
1894	2,737,973	62.4	170,787,338	53.6	91,526,787	43	58	40	70	572,957	1,341,533
1895	2,954,952	100.6	297,237,370	26.6	78,984,901	18	24	10	23	680,049	175,240
1896	2,767,465	91.1	252,234,540	28.6	72,182,350	18	26	19	26	926,646	246,178
1897	2,534,577	64.7	164,015,964	54.7	89,643,059	50	62	60	87	605,187	1,171,378
1898	2,557,729	75.2	192,306,338	41.4	79,574,772	30	36	33	52	579,833	530,420
1899	2,581,353	88.6	228,783,232	39.0	89,328,832	35	46	27	39	809,472	155,861
1900	2,611,054	80.8	210,926,897	43.1	90,811,167	40	48	35	60	741,483	371,911
1901	2,864,335	65.5	187,598,087	76.7	143,979,470	75	82	54	100	528,484	7,656,162
1902	2,965,587	96.0	284,632,787	47.1	134,111,436	42	48	42	60	843,075	358,505
1903	2,916,855	84.7	247,127,880	61.4	151,638,094	60	66				

MACHINERY IN POTATO GROWING.

Potato machinery, while not yet perfected, has reached such a degree of perfection that where potatoes are grown upon any considerable area special potato machinery should be provided. Implements should be purchased which are found adapted to the local conditions.

Acreage, production, and value of potatoes in the United States in 1903, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Maine	87,077	196	17,067,092	56	9,557,572
New Hampshire	18,277	98	1,791,146	65	1,164,245
Vermont	26,590	138	3,669,420	50	1,834,710
Massachusetts	28,874	96	2,771,904	71	1,968,052
Rhode Island	6,764	125	845,500	82	693,310
Connecticut	29,322	96	2,814,912	78	2,195,631
New York	394,870	89	35,143,430	56	19,680,321
New Jersey	57,681	99	5,710,716	69	3,940,394
Pennsylvania	244,153	91	22,217,923	62	13,775,112
Delaware	6,180	84	519,120	56	290,707
Maryland	28,513	70	1,995,910	60	1,197,546
Virginia	49,520	84	4,159,680	64	2,662,195
North Carolina	24,641	67	1,650,947	74	1,221,701
South Carolina	8,555	81	692,955	104	720,673
Georgia	8,628	73	629,844	94	592,053
Florida	3,489	82	286,098	126	360,483
Alabama	9,643	67	646,081	96	620,238
Mississippi	5,635	82	462,070	88	406,622
Louisiana	8,140	50	407,000	91	370,370
Texas	26,437	67	1,771,279	88	1,558,726
Arkansas	23,073	70	1,615,110	79	1,275,937
Tennessee	25,085	66	1,655,610	64	1,059,590
West Virginia	31,226	80	2,498,080	66	1,648,733
Kentucky	36,165	73	2,640,045	68	1,795,231
Ohio	161,917	83	13,441,601	61	8,199,377
Michigan	268,230	78	20,921,940	49	10,251,751
Indiana	77,888	76	5,919,488	66	3,906,862
Illinois	143,369	72	10,322,568	72	7,432,249
Wisconsin	252,522	58	14,646,276	58	8,494,840
Minnesota	140,015	64	8,960,960	61	5,466,186
Iowa	162,741	56	9,113,496	75	6,835,122
Missouri	86,977	66	5,740,482	76	4,362,766
Kansas	72,143	58	4,184,294	85	3,556,650
Nebraska	80,599	64	5,158,336	65	3,352,918
South Dakota	32,437	89	2,886,893	54	1,558,922
North Dakota	24,200	84	2,032,800	48	975,744
Montana	12,904	176	2,271,104	44	999,286
Wyoming	3,665	167	612,055	57	348,871
Colorado	50,758	145	7,359,910	60	4,415,946
New Mexico	1,297	87	112,839	84	94,785
Utah	11,776	177	2,084,352	47	979,645
Nevada	2,522	117	295,074	70	206,552
Idaho	11,672	160	1,867,520	46	859,059
Washington	29,411	145	4,264,595	36	1,535,254
Oregon	35,367	107	3,784,269	50	1,892,134
California	46,536	130	6,049,680	66	3,992,789
Oklahoma	10,227	78	797,706	98	781,752
Indian Territory	9,111	70	637,770	86	548,482
United States	2,916,855	84.7	247,127,880	61.4	151,638,094

Suggestions on Potato Cultivation.

The results of New York experiments in potato growing emphasize the importance of maintaining a sufficient supply of humus in the soil to conserve moisture. On a soil well supplied with humus the moisture may be conserved even through a severe drought, and a fair crop of potatoes produced. The great importance of thorough tillage has been very clearly brought out in these experiments, but it has also been shown that intensive tillage alone is not sufficient to produce a large yield of potatoes. In fact, intensive tillage may be overdone. During a drought only so much tillage is necessary as shall keep the surface mulch loose and thoroughly dry. The drier the surface layer of soil the more slowly will moisture be absorbed by it from the layers of subsurface soil. Harrowing potato land before the plants appear above ground is considered a wise practice. The use of Bordeaux mixture in nearly every case resulted in an increased yield, even when blight was not prevalent, and thorough spraying with this material is therefore recommended as a general practice. Pruning potato vines to one main stem was not beneficial.

Average yield per acre of potatoes in the United States, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	147	163	165	59	130	139	126	150	130	196
New Hampshire	120	134	108	51	90	127	101	108	120	98
Vermont	124	154	128	70	105	132	134	90	94	138
Massachusetts	105	133	108	62	97	134	79	77	109	96
Rhode Island	133	138	105	110	123	142	94	98	161	125
Connecticut	79	128	106	54	100	130	96	81	92	96
New York	77	122	89	62	73	88	81	78	66	89
New Jersey	60	94	91	68	75	83	69	59	132	99
Pennsylvania	64	111	109	63	54	85	58	62	83	91
Delaware	50	58	78	60	49	52	48	55	79	84
Maryland	52	87	90	74	58	64	55	60	80	70
Virginia	59	73	93	61	68	66	58	71	75	84
North Carolina	62	79	79	66	67	57	61	64	64	67
South Carolina	59	90	52	65	65	56	78	70	69	81
Georgia	52	58	55	52	54	46	68	64	58	73
Florida	90	55	75	75	64	69	60	62	90	82
Alabama	43	70	64	55	74	56	69	67	50	67
Mississippi	72	58	70	59	74	61	66	62	69	82
Louisiana	45	89	55	64	78	60	70	60	65	50
Texas	80	89	52	60	78	64	62	54	66	67
Arkansas	82	70	59	55	74	63	72	46	72	70
Tennessee	55	64	62	40	52	44	54	46	62	66
West Virginia	52	69	93	56	62	72	80	52	96	80
Kentucky	54	86	85	47	64	51	70	35	80	73
Ohio	63	63	89	42	61	71	76	54	94	83
Michigan	62	101	88	72	79	66	97	81	72	78
Indiana	59	66	85	31	71	76	83	31	101	76
Illinois	50	77	97	38	70	96	92	35	118	72
Wisconsin	45	107	78	99	98	103	103	75	115	58
Minnesota	39	158	84	106	85	96	81	68	98	64
Iowa	43	106	94	60	80	100	72	32	98	56
Missouri	69	109	78	42	66	82	93	17	128	66
Kansas	41	72	69	48	70	95	72	26	138	58
Nebraska	22	67	90	69	65	91	66	33	137	64
South Dakota	23	66	96	94	72	78	73	45	74	89
North Dakota	84	128	102	99	87	103	52	110	105	84
Montana	111	53	170	156	104	141	134	157	153	176
Wyoming	150	100	167	150	120	125	99	113	100	167
Colorado	85	95	88	97	77	84	56	120	100	145
New Mexico	75	80	72	90	58	49	19	50	72	87
Utah	135	172	155	148	135	120	118	114	157	177
Nevada	161	150	190	135	155	102	156	141	212	117
Idaho	178	105	162	140	120	124	136	108	149	160
Washington	125	149	125	162	108	144	116	117	136	145
Oregon	112	64	87	160	86	115	110	90	103	107
California	52	75	80	105	95	119	104	101	118	130
Oklahoma	......	......	......	......	......	......	......	55	97	78
Indian Territory	......	......	......	......	......	......	......	63	85	70
General average	62.4	100.6	91.1	64.7	75.2	88.6	80.8	65.5	96.0	81.7

Potatoes as Food for Man.

The potato is a staple article of diet in almost every household. The universality and extent of its consumption would seem sufficient to prove it to be a wholesome and nutritious food. The statement, however, is frequently met with in popular articles that potatoes are not a wholesome food. So far as can be learned this is a purely gratuitous assumption. While it is possible that there are persons with whom potatoes do not agree, or who for some reason are compelled to forego starchy foods, there is no reason to suppose that potatoes are not as a rule a useful and wholesome article of diet.

The most important groups of constituents in foods are protein (nitrogenous matter), fats, and carbohydrates (starches, sugars, etc.). The potato is essentially a starchy food, and eaten alone it would furnish a very one-sided, badly balanced diet, which would probably prove unwholesome to most people. When eaten with meat, eggs, fish, etc., which are essentially nitrogenous foods, an evenly balanced diet, which is most conducive to health and vigor, is secured.

Average value per acre of potatoes in the United States, based upon farm value December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$64.68	$55.42	$62.70	$52.51	$59.80	$58.38	$61.74	$100.50	$84.50	$109.76
New Hampshire	56.40	42.88	50.76	45.90	44.10	58.42	53.53	85.32	82.80	63.70
Vermont	54.56	40.04	37.12	49.00	44.10	47.52	53.60	57.60	54.52	69.00
Massachusetts	68.25	63.84	61.56	55.80	61.11	76.38	52.14	69.30	88.29	68.16
Rhode Island	95.76	62.10	56.70	106.70	78.72	71.00	65.80	91.14	123.00	102.50
Connecticut	53.72	52.48	48.76	48.60	55.00	59.80	67.20	76.14	67.16	74.88
New York	36.96	28.06	27.59	41.54	30.66	35.20	36.45	55.38	38.94	49.84
New Jersey	37.20	31.96	33.81	53.04	45.75	42.33	41.40	50.15	80.52	68.31
Pennsylvania	36.48	31.08	29.43	41.58	31.32	36.55	30.74	47.12	47.31	56.42
Delaware	25.00	22.01	27.30	39.00	33.81	26.52	28.80	42.90	40.29	47.04
Maryland	27.56	26.10	27.00	50.32	30.71	32.61	29.70	46.20	41.60	42.00
Virginia	33.04	27.74	31.62	42.70	37.40	36.96	34.22	52.54	43.50	53.76
North Carolina	37.20	43.45	33.97	42.24	11.51	37.62	39.65	46.08	42.88	49.58
South Carolina	45.43	65.70	34.32	68.25	65.00	58.24	78.00	77.00	66.24	84.24
Georgia	42.12	41.18	41.25	52.00	40.50	38.18	52.36	67.84	52.20	68.62
Florida	67.50	55.00	63.00	90.00	76.80	85.56	63.60	79.98	109.80	103.32
Alabama	37.84	56.70	48.00	51.70	61.42	48.72	56.58	73.03	46.50	64.32
Mississippi	59.04	37.12	43.40	48.38	53.28	62.22	54.78	71.30	63.48	72.16
Louisiana	37.35	61.08	41.80	54.40	58.50	48.60	55.30	60.60	53.30	45.50
Texas	79.20	69.42	40.56	57.00	67.08	58.24	51.56	67.50	56.10	58.96
Arkansas	43.46	35.70	31.27	46.20	40.70	41.73	41.04	57.96	48.96	55.30
Tennessee	26.95	25.60	24.80	29.20	29.64	28.60	31.32	39.56	39.68	42.24
West Virginia	29.64	28.98	28.83	36.40	33.48	37.44	40.80	44.20	48.96	52.80
Kentucky	30.21	33.54	28.05	31.49	29.44	31.11	35.00	30.45	42.40	49.64
Ohio	32.76	20.16	24.14	26.04	25.01	30.53	30.40	45.90	41.36	50.63
Michigan	26.66	16.16	16.72	30.96	21.33	21.12	25.22	55.08	29.52	38.22
Indiana	31.86	20.46	21.25	19.22	29.11	32.68	31.54	27.90	41.41	50.16
Illinois	32.00	23.10	25.22	23.56	32.20	39.36	37.72	32.55	49.56	51.84
Wisconsin	23.85	18.19	14.82	37.62	23.52	26.78	28.84	50.25	37.95	33.64
Minnesota	19.89	22.12	17.64	32.86	21.25	24.00	24.30	45.56	30.38	39.04
Iowa	29.67	20.14	20.68	28.20	24.00	23.00	26.64	30.08	33.32	42.00
Missouri	35.88	27.25	24.18	26.46	29.04	33.20	32.55	18.02	44.80	50.16
Kansas	27.88	30.24	18.63	26.40	35.70	42.75	34.56	27.04	62.10	49.30
Nebraska	16.94	20.10	22.50	31.74	24.05	23.50	32.34	34.65	36.99	41.60
South Dakota	17.02	17.16	19.20	30.08	20.16	21.06	26.28	38.25	32.56	48.06
North Dakota	38.64	21.76	21.42	32.67	29.58	27.81	25.48	53.90	34.65	40.32
Montana	53.28	25.44	54.40	62.40	57.20	74.73	71.02	114.61	76.50	77.44
Wyoming	90.00	56.00	71.81	82.50	78.00	76.25	67.32	112.40	65.27	95.19
Colorado	46.75	31.35	41.36	54.32	41.58	46.20	45.92	108.00	51.00	87.00
New Mexico	60.00	50.40	48.96	70.20	45.24	33.32	21.66	59.00	58.32	73.08
Utah	40.50	58.48	49.60	44.40	41.85	66.00	56.64	68.40	70.65	83.19
Nevada	56.35	57.00	72.20	98.55	139.50	91.80	87.36	128.31	133.56	81.90
Idaho	94.34	42.00	48.60	44.80	64.80	75.64	63.92	90.72	55.13	73.60
Washington	35.00	41.72	50.00	45.36	42.14	72.00	54.52	71.37	51.68	52.20
Oregon	40.32	21.96	33.93	64.00	40.42	56.35	49.50	63.00	56.65	53.50
California	25.48	36.00	42.40	51.45	52.25	74.97	55.12	77.77	68.44	85.80
Oklahoma	......	......	......	......	......	......	......	69.30	74.69	76.44
Indian Territory	......	......	......	......	......	......	......	78.12	54.40	60.20
General average	33.43	26.73	26.08	35.37	31.11	31.60	34.78	50.27	45.22	51.99

POTATOES AS FEED FOR LIVE STOCK.

Experiments made at the Minnesota Experiment Station have shown that while the digestibility of cooked and raw potatoes by pigs was about the same, pigs could be induced to eat larger quantities of cooked potatoes. It was calculated that a ration of 15 pounds of potatoes and 4 pounds of shorts would furnish an amount of protein sufficient for maintenance, leaving a margin for growth.

On the basis of cost comparisons were made of the value of potatoes and other feeding stuffs for stock. In the investigator's opinion, with foods at the present prices, it is doubtful whether it would be profitable to feed large amounts of potatoes to dairy stock, because cows require more protein than would be supplied by a fattening ration similar in character to that mentioned above.

Potatoes can not be fed to young animals as safely as to more mature ones, since if fed in too large quantities they have a tendency to prematurely fatten the animal. With mature animals, when the object is principally the addition of fat to the body, potatoes may be fed to good advantage.

Average farm price of potatoes per bushel in the United States December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	44	31	38	89	46	42	49	67	65	56
New Hampshire	47	32	47	90	49	46	53	79	69	65
Vermont	44	26	29	70	42	36	40	64	58	50
Massachusetts	65	48	57	90	63	57	66	90	81	71
Rhode Island	72	45	54	97	64	50	70	93	75	82
Connecticut	68	41	46	90	55	46	70	94	73	78
New York	48	23	31	67	42	40	45	71	59	56
New Jersey	62	34	36	78	61	51	60	85	61	69
Pennsylvania	57	28	27	66	58	43	53	76	57	62
Delaware	50	38	35	65	69	51	60	78	51	56
Maryland	53	30	30	68	53	51	54	77	52	60
Virginia	56	38	34	70	55	56	59	74	58	64
North Carolina	60	55	43	64	62	66	65	72	67	74
South Carolina	77	73	66	105	100	104	100	110	96	104
Georgia	81	71	75	100	75	83	77	106	90	94
Florida	75	100	84	120	120	124	106	129	122	126
Alabama	88	81	75	94	83	87	82	109	93	96
Mississippi	82	64	62	82	72	102	83	115	92	88
Louisiana	83	72	76	85	75	81	79	101	82	91
Texas	99	78	78	95	86	91	88	125	85	88
Arkansas	53	51	53	84	55	71	57	126	68	79
Tennessee	49	40	40	73	57	65	58	86	64	64
West Virginia	57	42	31	65	54	52	51	85	51	66
Kentucky	56	39	33	67	46	61	50	87	53	68
Ohio	52	32	26	62	41	43	40	85	44	61
Michigan	43	16	19	43	27	32	26	68	41	49
Indiana	54	31	25	62	41	43	38	90	41	66
Illinois	64	30	26	62	46	41	41	93	42	72
Wisconsin	53	17	19	38	24	26	28	67	33	58
Minnesota	51	14	21	31	25	25	30	67	31	61
Iowa	69	19	22	47	30	23	37	94	34	75
Missouri	52	25	31	63	44	40	35	106	35	76
Kansas	68	42	27	55	51	45	48	104	45	85
Nebraska	77	30	25	46	37	25	49	105	27	65
South Dakota	74	26	20	32	28	27	36	85	44	54
North Dakota	46	17	21	33	34	27	49	49	33	48
Montana	48	48	32	40	55	53	53	73	50	44
Wyoming	60	56	43	55	65	61	68	100	61	57
Colorado	55	33	47	56	54	55	82	90	51	60
New Mexico	80	63	68	78	78	68	114	118	81	84
Utah	30	34	32	30	31	55	48	60	45	47
Nevada	35	38	38	73	90	90	56	91	63	70
Idaho	53	40	30	32	54	61	47	84	37	46
Washington	28	28	40	28	39	50	47	61	38	36
Oregon	36	39	39	40	47	49	45	70	55	50
California	49	48	53	49	55	63	53	77	58	66
Oklahoma	......	......	......	......	......	......	......	126	77	98
Indian Territory	......	......	......	......	......	......	......	124	64	86
General average	53.6	26.6	28.6	51.7	41.4	39.0	43.1	76.7	47.1	61.4

How to Grow Early Potatoes.

At the Kansas Experiment Station seed tubers of four different varieties of medium-sized potatoes were placed in shallow boxes with the seed ends up in February. They were packed in sand, leaving the upper fourth of the tubers exposed, and the boxes were placed in a room with rather subdued light, having a temperature of 50° to 60° F. Vigorous sprouts soon pushed from the exposed eyes. The whole potatoes were planted in furrows in March in the same position they occupied in the boxes. The same varieties of potatoes taken from a storage cellar were planted in parallel rows. The sand-sprouted potatoes took the lead from the start in vigor and strength of top and produced potatoes the 1st of June, a week earlier than the storage-cellar potatoes. At the final digging they showed better potatoes and gave a 10 per cent larger total yield.

Wholesale prices of potatoes per bushel in leading cities of the United States, 1899–1903.

Date.	Cincinnati.		Chicago.		Milwaukee.		St. Louis.	
	Per barrel.		Burbank, per bushel.		Per bushel.		Burbank, per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.			*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	....	....	34	38	30	35	39½	45
February	....	....	34	50	30	45	42	55
March	....	....	48	75	40	65	53	75
April	....	....	49	68	45	60	56	72
May	$2.00	$6.00	33	52	25	55	40	55
June	1.50	2.50	34	60	20	40	42	52
July	1.15	2.00	28	28	20	75	....	....
August	1.10	1.50	....	....	20	35	25	30
September	1.40	1.60	30	40	20	30	32	40
October	....	....	26	34½	20	30	32	40
November	....	....	31	42	20	35	33	44
December	....	....	35	46	30	40	43	48
1900.	Per bushel.							
January	.45	.57	40	50	25	40	43	52
February	.45	.55	40	49	25	42	43	50
March	.43	.50	35	45	25	45	35	46
April	.32	.45	26	37	20	38	27	40
May	.33	.50	27	39	20	35	30	45
June	.35	.50	31	41	20	80	36	45
July	....	....	....	....	20	55	....	....
August	....	....	....	....	30	40	....	....
September	.40	.45	30	40	28	38	32	40
October	.32	.40	25	37	23	35	32	38
November	.38	.47	29	46	23	42	33	48
December	.40	.50	40	48	30	50	45	54
1901.								
January	.42	.50	40	49	38	50	45	54
February	.40	.48	38	43	35	50	18	20
March	.30	.47	38	42	35	45	37	43
April	.35	.45	30	42	32	45	41	45
May	.38	.75	35	60	35	60	39	53
June	.64	.90	35	78	30	80	50	80
July	....	....	....	....	65	125	....	....
August	.95	1.10	110	125	85	135	....	....
September	.75	1.20	56	107	40	110	70	140
October	.40	.75	59	68	40	75	70	75
November	.60	.95	59	82	60	82	83	100
December	.78	.90	75	82	65	87	83	83
1902.	Per barrel.							
January	2.20	2.40	70	80	72	87	78	83
February	2.10	2.40	68	76	72	85	78	84
March	2.10	2.60	68	80	70	85	76	90
April	2.45	3.00	72	100	70	103	81	105
May	2.25	3.00	58	100	50	103	90	105
June	2.10	2.40	47	60	40	90	72	80
July	.90	2.40	....	....	30	85	....	....
August	.90	1.05	....	....	28	50	....	....
September	.95	1.35	30	38	28	40	....	....
October	1.25	1.35	30	44	30	40	41	44
November	1.50	1.60	42	48	34	43	50	54
December	1.35	1.50	42	48	35	43	51	55
1903.								
January	1.65	1.80	45	48	40	45	50	55
February	1.50	1.60	45	47	38	40	51	54
March	1.50	1.70	43	47	35	40	50	53
April	1.35	1.65	38	46	35	40	42	54
May	1.65	1.90	42	60	35	52	45	63
June	1.50	3.00	50	85	46	90	65	125
July	1.75	2.25	....	....	35	75	40	65
August	1.75	1.95	....	....	40	70	None.	None.
September	1.50	1.80	....	....	35	60	None.	None.
October	1.20	1.80	54	60	45	60	55	72
November	1.20	2.10	50	70	50	65	67	80
December	1.80	2.10	60	66	55	65	65	68

HAY.

Condition of hay crop in United States, monthly, 1888–1903.

Year.	Clover. June.	Clover. July.	Timothy. July.	Timothy. Aug.	Year.	Clover. June.	Clover. July.	Timothy. July.	Timothy. Aug.
1888	......	......	......	......	1896	88.4	83.7	84.8	87.5
1889	......	......	......	94.5	1897	96.0	......	......	......
1890	95.1	94.0	93.9	93.6	1898	......	......	......	99.3
1891	91.0	89.3	87.4	90.9	1899	......	......	......	86.7
1892	94.9	95.5	96.8	93.2	1900	......	......	......	79.9
1893	92.7	92.6	89.8	89.6	1901	......	......	......	84.1
1894	87.8	80.2	77.3	75.6	1902	......	86.3	84.9	90.0
1895	82.8	73.9	70.8	69.9	1903	82.7	84.2	84.0	92.2

Acreage, production, value, prices, and exports of hay of the United States, 1866–1903.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per ton Dec. 1.	Farm value, Dec. 1.	Chicago prices of No. 1 timothy by carload lots. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.
	Acres.	*Tons.*	*Tons.*	*Dolls.*	*Dollars.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Tons.*
1866	17,668,904	1.23	21,778,627	10.14	220,835,771	......	......	......	......	5,028
1867	20,020,554	1.31	26,277,000	10.21	268,300,623	......	......	......	......	5,645
1868	21,541,573	1.21	26,141,900	10.08	263,589,235	......	......	......	......	......
1869	18,591,281	1.42	26,420,000	10.18	268,933,048	......	......	......	......	6,723
1870	19,861,805	1.23	24,525,000	12.47	305.743,224	......	......	......	......	4,581
1871	19,009,052	1.17	22,239,400	14.30	317,939,799	......	......	......	......	5,266
1872	20,318,936	1.17	23,812,800	12.94	308,024,517	......	......	......	......	4,557
1873	21,894,084	1.15	25,085,100	12.53	314,241,037	......	......	......	......	4,889
1874	21,769,772	1.15	25,133,900	11.94	300,222,454	......	......	......	......	7,183
1875	23,507,964	1.19	27,873,600	10.78	300,377,839	......	......	......	......	7,528
1876	25,282,797	1.22	30,867,100	8.97	276,991,422	......	......	9.00	10.00	7,287
1877	25,367,708	1.25	31,629,300	8.37	264,879,796	9.50	10.50	9.75	10.75	9,514
1878	26,931,300	1.47	39,608,296	7.20	285,015,625	8.00	8.50	9.00	11.50	8,127
1879	27,484,991	1.29	35,493,000	9.32	330,804,494	14.00	14.50	14.00	15.00	13,739
1880	25,863,955	1.23	31,925,233	11.65	371,811,084	15.00	15.50	17.00	19.00	12,662
1881	30,888,700	1.14	35,135,061	11.82	415,131,366	16.00	16.50	15.00	16.50	10,570
1882	32,339,585	1.18	38,138,049	9.70	371,170,326	11.50	12.25	12.00	13.00	13,309
1883	35,515,948	1.32	46,864,009	8.19	384,834,451	9.00	10.00	12.50	17.00	16,908
1884	38,571,593	1.26	48,470,460	8.17	396,139,309	10.00	11.50	15.50	17.50	11,142
1885	39,849,701	1.12	44,731,550	8.71	389,752,873	11.00	12.00	10.00	12.00	13,390
1886	36,501,688	1.15	41,796,499	8.46	353,437,699	9.50	10.50	11.00	12.50	13,873
1887	37,664,739	1.10	41,451,458	9.97	413,440,283	13.50	14.50	17.00	21.00	18,198
1888	38,591,903	1.21	46,643,094	8.76	408,499,565	11.00	11.50	10.50	11.00	21,928
1889	52,947,236	1.26	66,829,612	7.04	470,374,948	9.00	10.00	9.00	14.00	36,274
1890	50,712,513	1.19	60,197,589	7.87	473,569,972	9.00	10.50	12.50	15.50	28,066
1891	51,044,490	1.19	60,817,771	8.12	494,113,616	12.50	15.00	13.50	14.00	35,201
1892	50,853,061	1.18	59,823,735	8.20	490,427,798	11.00	11.50	12.00	13.50	33,084
1893	49,613,469	1.33	65,766,158	8.68	570,882,872	10.00	10.50	10.00	10.50	54,446
1894	48,321,272	1.14	54,874,408	8.54	468,578,321	10.00	11.00	10.00	10.25	47,117
1895	41,206,453	1.06	47,078,541	8.35	393,185,615	12.00	12.50	11.50	12.00	59,052
1896	43,259,756	1.37	59,282,158	6.55	388,145,614	8.00	8.50	8.50	9.00	61,658
1897	42,426,770	1.43	60,664,876	6.62	401,390,728	8.00	8.50	9.50	10.50	81,827
1898	42,780,827	1.55	66,376,920	6.00	398,060,647	8.00	8.25	9.50	10.50	64,916
1899	41,328,462	1.35	56,655,756	7.27	411,926,187	10.50	11.50	10.50	12.50	72,716
1900	39,132,890	1.28	50,110,906	8.89	445,538,870	11.50	14.00	12.00	13.50	89,364
1901	39,390,508	1.28	50,590,877	10.01	506,191,533	12.50	13.90	13.00	14.00	153,431
1902	39,825,227	1.50	59,857,576	9.06	542,036,364	12.00	13.00	13.50	15.00	50,974
1903	39,933,759	1.54	61,305,940	9.08	556,376,880	10.00	12.00	......	......	......

Acreage, production, and value of hay in the United States in 1903, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value Dec. 1.
	Acres.	*Tons.*	*Tons.*	*Dollars.*	*Dollars.*
Maine	1,265,541	.98	1,240,230	10.20	12,650,346
New Hampshire	619,592	.92	570,025	13.26	7,558,532
Vermont	861,997	1.18	1,017,156	10.88	11,066,657
Massachusetts	577,119	1.36	784,882	16.72	13,123,227
Rhode Island	65,901	1.07	70,514	18.95	1,336,240
Connecticut	475,246	1.11	527,523	15.19	8,013,074
New York	4,813,428	1.26	6,064,919	10.96	66,471,512
New Jersey	416,243	1.28	532,791	15.39	8,199,653
Pennsylvania	3,072,329	1.27	3,901,858	13.50	52,675,083
Delaware	74,816	1.64	122,747	14.83	1,820,338
Maryland	295,161	1.24	366,000	14.02	5,131,320
Virginia	463,455	1.30	602,492	13.73	8,272,215
North Carolina	129,492	1.60	207,187	13.42	2,780,450
South Carolina	61,319	1.46	89,526	11.72	1,049,245
Georgia	88,961	1.53	136,110	15.15	2,062,066
Florida	13,297	1.47	19,547	18.82	367,875
Alabama	56,941	1.77	100,786	12.39	1,248,739
Mississippi	46,201	1.74	80,390	11.60	932,524
Louisiana	21,705	2.04	44,278	11.35	502,555
Texas	416,224	1.84	765,852	8.20	6,279,986
Arkansas	79,389	1.60	127,022	9.48	1,204,169
Tennessee	353,479	1.58	558,497	12.29	6,863,928
West Virginia	522,820	1.38	721,492	13.80	9,956,590
Kentucky	495,202	1.46	722,995	12.07	8,726,550
Ohio	2,740,862	1.42	3,892,024	10.00	38,920,240
Michigan	2,215,503	1.37	3,035,239	8.93	27,104,684
Indiana	1,768,843	1.47	2,600,199	8.56	22,257,703
Illinois	2,774,843	1.54	4,273,258	8.33	35,596,239
Wisconsin	1,754,724	1.89	3,316,428	7.50	24,873,210
Minnesota	858,550	1.84	1,579,732	6.61	10,442,029
Iowa	3,163,962	1.78	5,631,852	5.46	30,749,912
Missouri	3,022,492	1.57	4,745,312	6.68	31,698,684
Kansas	1,813,380	1.58	2,865,140	4.81	13,781,323
Nebraska	561,962	1.68	944,096	4.48	4,229,550
South Dakota	191,291	1.45	277,372	4.63	1,284,232
North Dakota	148,962	1.18	175,775	4.64	815,596
Montana	335,558	2.08	697,961	8.81	6,149,036
Wyoming	174,753	2.14	373,971	6.67	2,494,387
Colorado	622,171	2.56	1,592,758	7.48	11,913,830
New Mexico	68,473	2.36	161,596	11.12	1,796,948
Arizona	79,805	3.46	276,125	10.34	2,855,132
Utah	347,863	2.95	1,026,196	6.84	7,019,181
Nevada	142,002	3.12	443,046	9.97	4,417,169
Idaho	347,193	2.82	979,084	6.86	6,817,516
Washington	313,178	2.41	754,759	12.77	9,638,272
Oregon	364,149	2.07	753,788	10.18	7,673,562
California	550,270	2.08	1,144,562	11.66	13,345,593
Oklahoma	248,591	1.34	333,112	5.61	1,868,758
Indian Territory	38,491	1.50	57,736	5.91	341,220
United States	39,933,759	1.54	61,305,910	9.08	556,376,880

Value of Salt-marsh Hay.

In certain parts of the country, especially along the New England coast, there are extensive salt marshes which yield an abundant growth of the coarser grasses, locally known as black grass, fox grass, branch grass, blue grass (variety of redtop), cove hay, salt hay mixture, and flat sage. These grasses are cut and used as feed to a considerable extent in some localities, but no accurate experiments had been made to determine the actual feeding value of the different kinds of grasses until the Massachusetts Hatch Station undertook this work. In the experiments of the Massachusetts station the hays were analyzed, their digestibilities were determined by the aid of sheep, and their effects upon the quantity, as well as their influence upon the quality, of both milk and butter were carefully noted. The opinion was reached that salt-marsh hay is not so valuable as ordinary hay of mixed grasses, but that it affords a quite valuable forage, especially to be recommended when other hay is high in price.

Average yield per acre of hay in the United States, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Maine	0.95	1.02	1.00	1.10	1.20	0.90	0.90	1.05	1.07	0.98
New Hampshire	.95	.95	.96	1.15	1.25	.89	.87	1.28	1.06	.92
Vermont	1.20	1.07	1.25	1.30	1.45	1.14	1.24	1.36	1.27	1.18
Massachusetts	1.26	1.11	1.28	1.40	1.42	1.13	.97	1.21	1.60	1.36
Rhode Island	.75	.91	1.10	1.15	1.18	.89	.92	.92	1.03	1.07
Connecticut	.87	.85	1.07	1.20	1.31	.94	.89	1.01	1.35	1.11
New York	1.17	.73	.81	1.35	1.40	1.04	.81	1.30	1.34	1.26
New Jersey	1.16	1.21	1.15	1.75	1.42	.83	1.26	1.32	1.22	1.28
Pennsylvania	1.18	1.01	1.06	1.40	1.45	1.20	1.10	1.19	1.19	1.27
Delaware	1.30	1.23	1.10	1.35	1.38	1.04	.98	1.12	1.09	1.64
Maryland	1.03	1.25	.87	1.35	1.20	1.13	1.09	1.22	1.01	1.24
Virginia	.72	1.13	1.08	1.08	1.32	1.10	1.16	1.20	1.06	1.30
North Carolina	1.45	1.63	1.26	1.25	1.70	1.50	1.41	1.66	1.44	1.60
South Carolina	1.53	1.00	1.33	1.00	1.60	1.22	1.32	1.46	1.22	1.46
Georgia	1.16	1.60	1.38	1.35	1.75	1.45	1.69	1.46	1.36	1.53
Florida	1.23	1.53	1.40	1.00	1.60	1.46	1.20	1.48	1.24	1.47
Alabama	2.68	1.56	1.40	1.45	1.90	1.66	1.85	1.75	1.50	1.77
Mississippi	1.84	1.95	1.35	1.48	1.90	1.44	1.75	1.69	1.40	1.74
Louisiana	1.96	2.02	1.90	1.90	2.10	1.95	2.00	1.85	1.80	2.04
Texas	1.33	1.48	1.00	1.40	1.50	1.43	1.80	1.25	1.40	1.84
Arkansas	1.32	1.20	1.18	1.30	1.54	1.48	1.63	1.10	1.60	1.60
Tennessee	1.18	1.39	1.40	1.45	1.50	1.31	1.40	1.52	1.44	1.58
West Virginia	1.02	.71	1.22	1.35	1.54	1.29	1.18	1.37	1.12	1.38
Kentucky	1.26	1.35	1.20	1.17	1.45	1.29	1.40	1.34	1.44	1.46
Ohio	1.27	.58	1.26	1.44	1.39	1.30	1.06	1.36	1.43	1.42
Michigan	1.20	.58	1.16	1.49	1.36	1.22	1.29	1.26	1.45	1.37
Indiana	1.27	.61	1.30	1.43	1.45	1.34	1.21	1.27	1.46	1.47
Illinois	1.14	.66	1.38	1.29	1.56	1.29	1.27	1.08	1.50	1.54
Wisconsin	1.31	.88	1.25	1.35	1.50	1.47	1.15	1.29	1.90	1.89
Minnesota	1.02	1.30	1.69	1.57	1.80	1.70	1.16	1.55	1.76	1.84
Iowa	.73	1.08	1.74	1.50	1.75	1.34	1.42	1.25	1.68	1.78
Missouri	.85	1.17	1.43	1.15	1.60	1.37	1.29	.75	1.59	1.57
Kansas	.77	1.24	1.42	1.30	1.46	1.57	1.32	.91	1.70	1.58
Nebraska	.59	.99	1.66	1.60	1.60	1.66	1.38	1.25	1.74	1.68
South Dakota	.94	.79	1.28	1.25	1.38	1.43	1.18	1.15	1.23	1.45
North Dakota	1.19	1.42	1.65	1.60	1.50	1.58	.92	1.60	1.66	1.18
Montana	1.20	.94	1.38	1.50	1.45	1.42	1.60	1.79	1.68	2.08
Wyoming	1.60	1.08	1.55	1.65	1.96	1.47	1.68	1.76	1.65	2.14
Colorado	2.27	2.42	2.20	2.25	2.20	2.10	2.23	2.08	1.92	2.56
New Mexico	1.88	2.61	3.00	3.50	3.75	1.70	2.06	2.31	2.40	2.36
Arizona	1.82	1.85	3.20	3.00	3.50	2.63	2.31	2.85	2.34	3.46
Utah	2.52	2.56	2.70	2.95	3.25	2.50	2.65	2.45	2.62	2.95
Nevada	4.04	3.01	2.55	2.50	2.60	1.87	2.43	2.50	2.91	3.12
Idaho	2.53	2.57	2.60	2.30	3.75	2.50	2.80	2.58	2.67	2.82
Washington	2.05	1.85	1.95	2.25	1.75	2.02	2.16	2.30	2.29	2.41
Oregon	2.00	1.78	1.98	1.90	1.90	1.97	2.35	2.07	2.04	2.07
California	1.93	1.66	1.65	1.60	1.60	1.63	1.51	1.82	1.81	2.08
Oklahoma	......	......	......	......	......	......	......	.96	1.26	1.34
Indian Territory	......	......	......	......	......	......	......	1.46	1.32	1.50
General average	1.14	1.06	1.37	1.43	1.55	1.35	1.28	1.28	1.50	1.54

CHANGES IN WEIGHT OF HAY IN BARN AND STACK.

A considerable difference in shrinkage occurs between hay cured in dry weather and hay cured when the atmosphere is more or less moist. For this reason the shrinkage in hay in a dry climate is usually smaller than in the more humid regions. At the Kansas Experiment Station small quantities of 13 different kinds of hay buried in the mow from 4 to 6 months shrunk 4.5 per cent on an average, ranging from a 14 per cent loss to a 3 per cent gain. Five tons of very dry timothy hay stored in a mow for 6 months at the Michigan Experiment Station lost nearly 7 per cent, and in another test 5,600 pounds of the same kind of hay in good condition placed in the mow July 6 had lost 776 pounds, or 13.8 per cent, by February 18 following. Practical men estimate that hay put in the mow when in good condition usually shrinks about 20 per cent by the time it is baled. The Utah Experiment Station has reported a loss of a little over 15 per cent in a ton of timothy hay after it had been kept in the barn for 9 months. A stack of timothy hay containing a little over 2 tons and built in the open had gained a little over 1 per cent during the same time. The results with clover hay at the same station show a loss of 3.75 per cent during 9 months when kept in the barn and a gain of 10 per cent for the same period when stacked out of doors.

Average value per acre of hay in the United States, based upon farm value December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$9.12	$9.87	$10.25	$10.73	$9.12	$9.09	$11.66	$10.96	$10.74	$10.00
New Hampshire	9.97	11.88	12.38	13.23	11.56	10.46	13.48	15.87	14.36	12.20
Vermont	11.93	13.11	12.85	12.03	9.21	10.55	13.70	13.36	12.26	12.84
Massachusetts	19.53	19.42	20.99	19.46	17.18	17.52	16.88	21.16	26.64	22.74
Rhode Island	12.25	15.70	18.26	16.67	14.93	15.35	17.20	17.54	19.46	20.28
Connecticut	13.54	13.68	15.74	15.60	14.61	13.63	14.89	14.77	21.19	16.86
New York	11.30	10.00	9.75	11.14	8.05	10.87	11.38	13.75	14.11	13.81
New Jersey	16.34	15.29	16.50	18.81	13.63	12.74	20.22	18.86	19.08	19.70
Pennsylvania	13.35	12.42	12.88	12.81	11.46	13.80	15.29	15.90	16.66	17.15
Delaware	19.50	14.96	14.30	13.50	11.66	12.12	13.67	13.84	15.73	24.32
Maryland	11.46	14.41	10.31	14.17	11.16	13.73	15.31	16.07	14.19	17.38
Virginia	8.56	12.92	11.03	11.07	11.22	11.27	15.43	14.41	14.39	17.85
North Carolina	15.85	16.53	13.55	12.19	15.81	15.15	15.79	17.93	17.64	21.47
South Carolina	16.45	7.62	15.06	11.50	15.20	12.56	15.18	16.03	13.72	17.11
Georgia	14.36	17.44	15.25	17.55	20.56	19.07	21.55	20.92	18.22	23.18
Florida	19.99	20.24	18.20	14.25	22.56	22.41	16.44	22.72	19.02	27.67
Alabama	25.49	15.93	13.72	13.86	17.57	18.92	19.52	21.12	17.42	21.93
Mississippi	17.79	18.91	12.77	14.06	15.96	13.32	17.41	17.62	14.35	20.18
Louisiana	28.85	19.47	16.63	16.62	19.74	18.92	18.80	20.50	21.10	23.15
Texas	10.13	9.52	7.20	10.15	8.77	10.15	12.24	13.27	12.04	15.09
Arkansas	11.66	11.12	8.90	11.25	10.39	12.80	14.43	12.89	15.04	15.17
Tennessee	13.30	15.05	13.54	15.59	14.25	14.74	16.52	18.71	16.99	19.42
West Virginia	10.87	9.04	11.94	11.95	12.94	12.19	15.81	18.91	16.05	19.04
Kentucky	13.19	14.77	11.35	11.70	13.19	13.42	15.89	16.25	16.27	17.62
Ohio	10.74	7.40	9.99	9.00	7.99	11.63	11.71	11.86	14.59	14.20
Michigan	10.85	7.59	9.84	11.55	9.72	10.37	12.19	10.85	12.03	12.23
Indiana	9.63	7.34	9.33	8.44	8.12	10.45	11.80	11.79	12.66	12.58
Illinois	9.50	6.77	8.82	7.93	9.20	10.00	10.67	12.10	13.31	12.83
Wisconsin	10.42	8.47	8.25	8.44	8.62	10.07	11.10	13.58	15.03	14.17
Minnesota	5.41	6.66	6.41	7.06	6.66	7.40	8.06	8.65	9.43	12.16
Iowa	5.39	6.97	6.94	6.37	7.09	7.10	9.66	9.59	10.92	9.72
Missouri	6.65	7.96	6.94	7.07	9.28	8.56	8.97	8.99	10.96	10.49
Kansas	4.04	4.04	3.83	4.42	4.74	5.49	6.01	7.25	7.33	7.60
Nebraska	4.20	3.52	4.05	4.80	5.28	6.14	7.11	7.71	7.59	7.53
South Dakota	4.02	2.60	3.99	3.69	4.14	4.43	4.66	5.16	5.10	6.71
North Dakota	4.61	4.94	5.59	5.20	4.87	5.21	5.20	5.84	6.09	5.48
Montana	8.60	10.72	9.47	11.63	9.86	10.93	13.92	14.60	12.67	18.32
Wyoming	16.10	7.02	11.07	9.90	11.40	9.70	12.26	12.64	12.01	14.27
Colorado	17.12	14.21	13.68	12.38	11.88	15.43	16.95	18.80	18.99	19.15
New Mexico	21.62	20.88	17.10	24.50	27.56	18.02	20.39	23.89	26.83	26.24
Arizona	21.84	16.65	28.00	15.00	42.00	27.22	26.10	26.16	28.62	35.78
Utah	14.01	13.49	13.50	14.01	14.62	17.75	21.07	20.70	19.18	20.18
Nevada	29.29	20.32	12.29	12.50	18.20	14.31	18.71	19.80	29.73	31.11
Idaho	10.98	16.06	12.25	12.08	18.37	15.75	18.20	15.25	14.69	19.64
Washington	15.13	12.49	13.83	20.25	13.30	17.98	20.52	19.60	20.45	30.78
Oregon	11.72	10.89	13.07	14.73	13.78	13.49	15.98	14.82	15.26	21.07
California	18.34	11.72	10.48	14.40	22.80	13.04	12.31	14.41	17.03	24.25
Oklahoma	......	......	......	......	......	......	......	6.59	6.68	7.52
Indian Territory	......	......	......	......	......	......	......	11.01	6.57	8.86
General average	9.70	8.89	8.97	9.46	9.30	9.97	11.39	12.85	13.61	13.93

INFLUENCE OF MATURITY ON SHRINKAGE OF HAY.

The results of experiments conducted by different stations show that the degree of maturity at which hay is cut influences very largely the shrinkage during curing. At the Pennsylvania Station early-cut hay lost on an average 29 per cent in weight, while late-cut hay lost only 21.5 per cent. Timothy, cut when just beginning to head, lost 75 per cent of water in curing; when cut at the beginning of the blossoming period, 66 per cent; and cut a little later, or about the usual time, 57 per cent. The Michigan Station found a shrinkage of about 60 per cent in curing clover. At the New York State Station, meadow fescue, mixed with a little red clover, lost in one lot 62.68 per cent and in another 58.25 per cent during curing. The moisture retained in cured fodder varies with different kinds. Atwater states that for New England timothy hay retains on an average 12 per cent of moisture, clover hay 14 per cent, and corn fodder 25 per cent.

Average farm price of hay per ton in the United States December 1, 1894–1903, by States.

States and Territories.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Maine	$9.60	$9.68	$10.25	$9.75	$7.60	$10.10	$12.95	$10.44	$10.04	$10.20
New Hampshire	10.50	12.50	12.90	11.50	9.25	11.75	15.50	12.40	13.55	13.26
Vermont	9.94	12.25	10.28	9.25	6.35	9.25	11.05	9.82	9.65	10.88
Massachusetts	15.50	17.50	16.40	13.90	12.10	15.50	17.40	17.49	16.65	16.72
Rhode Island	16.33	17.25	16.60	14.50	12.65	17.25	18.70	19.06	18.89	18.95
Connecticut	15.56	16.10	14.71	13.00	11.15	14.50	16.73	14.62	15.70	15.19
New York	9.66	13.70	12.04	8.25	5.75	10.45	14.05	10.58	10.53	10.96
New Jersey	14.09	12.64	14.35	10.75	9.60	15.35	16.05	14.29	15.64	15.39
Pennsylvania	11.31	12.30	12.15	9.15	7.90	11.50	13.90	13.64	14.00	13.50
Delaware	15.00	12.16	13.00	10.00	8.45	11.65	13.95	12.36	14.43	14.83
Maryland	11.13	11.55	11.85	10.50	9.30	12.15	14.05	13.17	14.05	14.02
Virginia	11.89	11.43	10.21	10.25	8.50	10.25	13.30	12.01	13.58	13.73
North Carolina	10.93	10.14	10.75	9.75	9.30	10.10	11.20	10.80	12.25	13.42
South Carolina	10.75	7.62	11.32	11.50	9.50	10.30	11.50	10.98	11.25	11.72
Georgia	12.38	10.90	11.05	13.00	11.75	13.15	12.75	14.33	13.40	15.15
Florida	16.25	13.23	13.00	14.25	14.10	15.35	13.70	15.35	15.34	18.82
Alabama	9.51	10.21	9.80	10.25	9.25	11.40	10.55	12.07	11.61	12.39
Mississippi	9.67	9.70	9.46	9.50	8.40	9.25	9.95	10.51	10.25	11.60
Louisiana	10.64	9.64	8.75	8.75	9.40	9.70	9.40	11.08	11.72	11.35
Texas	7.62	6.43	7.20	7.75	5.85	7.10	6.80	10.62	8.60	8.20
Arkansas	8.83	9.27	7.54	8.65	6.75	8.65	8.85	11.72	9.40	9.48
Tennessee	11.27	10.83	9.67	10.75	9.50	11.25	11.80	12.31	11.80	12.29
West Virginia	10.66	12.73	9.79	8.85	8.40	9.45	13.40	13.80	14.33	13.80
Kentucky	10.47	10.94	9.46	10.00	9.10	10.40	11.35	12.13	11.30	12.07
Ohio	8.46	12.76	7.93	6.25	5.75	8.95	11.05	8.72	10.20	10.00
Michigan	9.04	13.09	8.48	7.75	7.15	8.50	9.45	8.61	8.30	8.93
Indiana	7.58	12.03	7.18	5.90	5.60	7.80	9.75	9.28	8.67	8.56
Illinois	8.33	10.25	6.39	6.15	5.90	7.75	8.40	11.20	8.87	8.33
Wisconsin	7.96	9.63	6.60	6.25	5.75	6.85	9.65	10.53	7.91	7.50
Minnesota	5.30	5.12	3.79	4.50	3.70	4.35	6.95	5.58	5.36	6.61
Iowa	7.39	6.45	3.99	4.25	4.05	5.30	6.80	7.67	6.50	5.46
Missouri	7.82	6.80	4.85	6.15	5.80	6.25	6.95	11.99	6.89	6.68
Kansas	5.25	3.26	2.70	3.40	3.25	3.50	4.55	7.67	4.31	4.81
Nebraska	7.12	3.56	2.44	3.00	3.30	3.70	5.15	6.17	4.36	4.48
South Dakota	4.28	3.29	3.12	2.95	3.00	3.10	3.95	4.49	4.15	4.63
North Dakota	3.87	3.48	3.39	3.25	3.25	3.30	5.65	3.65	3.67	4.64
Montana	7.17	11.40	6.86	7.75	6.80	7.70	8.70	8.18	7.54	8.81
Wyoming	10.00	6.50	7.14	6.00	5.90	6.60	7.30	7.18	7.28	6.67
Colorado	7.54	5.87	6.22	5.50	5.40	7.35	7.60	9.04	9.89	7.48
New Mexico	11.50	8.00	5.70	7.00	7.35	10.60	9.90	10.34	11.18	11.12
Arizona	12.00	9.00	8.75	5.00	12.00	10.35	11.30	9.18	12.23	10.34
Utah	5.56	5.27	5.00	4.75	4.50	7.10	7.95	8.45	7.32	6.84
Nevada	7.25	6.75	4.82	5.00	7.00	7.65	7.70	7.92	9.05	9.97
Idaho	4.34	6.25	4.71	5.25	4.90	6.30	6.50	5.91	5.50	6.86
Washington	7.38	6.75	7.09	9.00	7.60	8.90	9.50	8.52	8.93	12.77
Oregon	5.86	6.12	6.60	7.75	7.25	6.85	6.80	7.16	7.48	10.18
California	9.50	7.06	6.35	9.00	14.25	8.00	8.15	7.92	9.41	11.66
Oklahoma	......	......	......	......	......	......	......	6.86	5.30	5.61
Indian Territory	......	......	......	......	......	......	......	7.54	4.98	5.91
General average	8.54	8.35	6.55	6.62	6.00	7.27	8.89	10.01	9.06	9.08

Spontaneous Combustion of Hay.

Fires which are reported to be caused by the spontaneous combustion of hay are by no means rare. While some of them are doubtless of an incendiary origin, others are really due to the cause assigned. Such a case is reported from the Pennsylvania Experiment Station. The fire was discovered in the haymow of the station barn. The mow was directly over the cow stable. Precautions were taken to exclude drafts and, as there was a sufficient supply of water available, the fire after a time was extinguished. The fire was confined to the central portion of the hay and a number of holes were burned through the ceiling of the cow stable. These were so situated that it apparently would have been impossible for the fire to have originated from any other cause than spontaneous combustion. A considerable part of the hay was thrown out of the mow. An examination showed that a large portion of it was so thoroughly charred that it would crumble. Some of the hay had not been subjected to so great heat and was only browned in color. However, it was unfit for stock feeding.

For several days previous to the fire a peculiar odor had been noticed about the barn and a somewhat careful examination was made to ascertain its source. The rowen in the mow was found to be heating, but no danger of fire was suspected.

Wholesale prices of hay (baled) per ton in leading cities of the United States, 1899–1903.

Date.	Chicago. No. 1 timothy, per ton.		Cincinnati. No. 1 timothy, per ton.		St. Louis. No. 1 timothy, per ton.	
	Low.	High.	Low.	High.	Low.	High.
1899.						
January	$8.00	$8.50	$7.75	$8.50	$8.00	$9.90
February	8.00	8.50	8.00	8.75	8.00	8.75
March	8.50	9.25	9.00	11.00	8.00	10.00
April	9.50	10.50	10.50	11.50	9.00	11.00
May	10.00	10.50	10.50	11.00	10.50	11.50
June	10.50	11.00	10.50	12.00	10.50	11.50
July	11.50	12.00	9.00	12.50	10.00	12.00
August	11.00	12.00	9.00	10.50	8.00	12.00
September	11.00	11.50	9.00	11.25	8.00	10.50
October	11.50	12.00	11.00	12.00	9.50	10.50
November	11.50	12.00	11.50	13.00	10.00	10.75
December	11.00	12.00	12.00	13.00	10.00	11.50
1900.						
January	10.50	11.00	13.00	14.00	11.00	12.50
February	10.50	10.75	13.50	14.00	10.50	12.00
March	10.50	11.00	13.75	14.25	11.00	12.50
April	11.00	13.00	14.50	15.00	11.50	13.00
May	11.50	12.00	14.25	15.00	11.00	13.50
June	10.00	11.00	14.00	14.75	10.50	13.50
July	10.50	12.00	13.75	14.25	11.00	14.50
August	11.00	11.50	11.50	15.00	9.75	13.00
September	11.00	11.50	12.50	13.75	10.00	12.00
October	11.00	11.50	13.50	14.50	11.00	12.50
November	12.00	13.50	13.50	14.00	10.75	13.50
December	12.50	13.50	13.75	14.50	11.50	14.00
1901.						
January	12.00	13.00	14.00	14.50	11.50	13.50
February	12.00	12.50	14.00	14.25	11.50	12.75
March	12.00	13.00	13.50	14.50	11.50	14.00
April	12.50	13.00	14.00	15.50	12.50	14.50
May	12.50	13.50	14.25	14.50	12.00	14.50
June	12.50	13.00	12.50	13.50	12.00	15.50
July	13.00	14.00	12.25	15.00	12.50	17.50
August	13.00	14.00	12.25	15.00	13.00	16.00
September	12.00	12.50	12.50	13.25	12.50	15.50
October	12.00	12.50	12.50	13.25	12.50	14.50
November	13.00	13.50	12.50	13.25	13.00	14.50
December	13.00	13.50	13.00	14.00	13.50	15.00
1902.						
January	12.50	13.00	12.50	13.75	13.50	15.50
February	12.00	12.50	12.50	13.25	13.00	14.50
March	12.00	12.50	12.75	13.25	13.00	14.50
April	12.50	13.00	12.75	13.25	13.00	15.25
May	12.50	13.50	13.00	13.50	13.00	15.50
June	12.00	12.50	12.75	13.00	12.00	15.00
July	12.00	12.50	13.75	15.50	13.00	16.00
August	12.00	12.50	12.00	15.50	10.00	15.00
September	12.00	12.50	11.00	13.00	9.50	12.00
October	12.00	12.50	13.00	14.00	11.00	13.00
November	12.00	12.50	13.00	14.00	11.00	13.50
December	12.00	12.50	13.75	16.50	13.50	15.50
1903.						
January	12.00	13.00	15.50	17.25	13.50	15.50
February	12.00	13.00	16.00	16.75	13.50	15.00
March	12.00	13.50	16.00	17.50	14.00	16.00
April	13.00	15.00	16.25	18.00	13.50	16.00
May	13.50	15.00	15.25	18.00	13.00	16.00
June	13.00	15.00	17.50	19.50	14.50	25.00
July	13.00	13.50	16.50	18.00	9.50	16.50
August	11.00	13.50	11.50	17.00	10.00	15.00
September	10.00	12.00	11.50	13.50	10.00	12.00
October	10.00	11.50	12.50	13.25	10.00	12.50
November	10.00	11.50	12.25	12.75	10.00	12.50
December	10.00	12.00	12.50	13.00	10.00	13.50

COTTON.

Commercial cotton crop of 1901–1902.

[In commercial bales.]

States and Territories.	Movement and mill purchases.			Taken from other States and ports.			Total commercial crop.
	Forwarded by rail, etc.	Bought by mills.	Total.	Taken from other States.	Taken from ports.	Total.	
Alabama	1,010,217	196,137	1,206,354	72,128	3,132	75,260	1,131,094
Arkansas	829,221	2,096	831,317	26,824	....	26,824	804,493
Florida	50,510	....	50,510	8	....	8	50,502
Georgia	1,414,872	381,960	1,796,832	195,295	3,345	198,640	1,598,192
Indian Territory	270,950	....	270,950	2,427	....	2,427	268,523
Kansas	171	229	400	229	....	229	171
Kentucky	71	23,917	23,988	23,917	....	23,917	71
Louisiana	1,028,821	17,843	1,046,664	148,091	17,762	165,853	880,811
Mississippi	1,436,273	32,618	1,468,891	63,399	149	63,548	1,405,343
Missouri	23,924	4,322	28,246	4,322	....	4,322	23,924
North Carolina	265,188	509,486	774,674	168,684	6,322	175,006	599,668
Oklahoma	145,396	....	145,396	942	....	942	144,454
South Carolina	423,690	607,906	1,031,596	184,507	3,429	187,936	843,660
Tennessee	188,599	45,240	233,839	40,901	16	40,917	192,922
Texas	2,742,257	18,741	2,760,998	56,519	....	56,519	2,704,479
Virginia	14,688	40,866	55,554	40,866	....	40,866	14,688
United States	9,844,848	1,881,361	11,726,209	1,029,059	34,155	1,063,214	10,662,995

Value of the commercial crop of 1901–1902.

States and Territories.	Upland crop.				Sea-island crop.				Total value.
	Production.	Weight per bale.	Price per pound.	Value.	Production.	Weight per bale.	Price per pound.	Value.	
	Bales.	*Lbs.*	*Cents.*	*Dollars.*	*Bales.*	*Lbs.*	*Cents.*	*Dollars.*	*Dollars.*
Alabama	1,131,094	513	7.74	44,911,445	......	......	......	......	44,911,445
Arkansas	804,493	511	7.23	29,722,235	......	......	......	......	29,722,235
Florida	29,179	494	7.76	1,118,559	21,323	395	20.5	1,726,630	2,845,189
Georgia	1,549,654	494	7.76	59,405,056	48,538	395	18.0	3,451,052	62,856,108
Indian Territory	268,523	522	7.97	11,171,470	......	......	......	......	11,171,470
Kansas	171	500	7.23	6,182	......	......	......	......	6,182
Kentucky	71	500	7.23	2,567	......	......	......	......	2,567
Louisiana	880,811	511	7.20	32,406,798	......	......	......	......	32,406,798
Mississippi	1,405,343	511	7.20	51,705,380	......	......	......	......	51,705,380
Missouri	23,924	511	7.23	883,879	......	......	......	......	883,879
North Carolina	599,668	489	7.96	23,341,717	......	......	......	......	23,341,717
Oklahoma	144,454	522	7.23	5,451,781	......	......	......	......	5,451,781
South Carolina	834,886	485	7.77	31,462,261	8,774	369	24.0	777,025	32,239,286
Tennessee	192,922	511	7.85	7,738,777	......	......	......	......	7,738,777
Texas	2,704,479	522	7.97	112,515,522	......	......	......	......	112,515,522
Virginia	14,688	479	7.96	560,030	......	......	......	......	560,030
United States	10,584,360	509	7.66	412,403,659	78,635	392	19.0	5,954,707	418,358,366

Condition of cotton crop in the United States, monthly, 1888–1903.

Year.	June.	July.	August.	September.	October.	Year.	June.	July.	August.	September.	October.
1888	88.2	86.7	87.3	83.8	78.9	1896	97.2	92.5	80.1	64.2	60.7
1889	86.4	87.6	89.3	86.6	81.5	1897	83.5	86.0	86.9	78.3	70.0
1890	88.8	91.4	89.5	85.5	80.0	1898	89.0	91.2	91.2	79.8	75.4
1891	85.7	88.6	88.9	82.7	75.7	1899	85.7	87.8	84.0	68.5	62.4
1892	85.9	86.9	82.3	76.8	73.3	1900	82.5	75.8	76.0	68.2	67.0
1893	85.6	82.7	80.4	73.4	70.7	1901	81.5	81.1	77.2	71.4	61.4
1894	88.3	89.6	91.8	85.9	82.7	1902	95.1	84.7	81.9	64.0	58.3
1895	81.0	82.3	77.9	70.8	65.1	1903	74.1	77.1	79.7	81.2	65.1

Acreage, production, value, prices, and exports of cotton of the United States, 1880–1902.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per pound Dec. 1.	Value.	New York closing prices per pound on middling upland. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports fiscal years beginning July 1.
	Acres.	*Bales.*	*Bales.*	*Cents.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bales of 500 pounds.*
1880	15,475,300	0.43	6,605,750	9.8	280,266,242	$11\frac{7}{8}$	12	$10\frac{7}{16}$	$10\frac{7}{8}$	4,381,857
1881	16,710,730	.33	5,456,048	10.0	294,135,547	$11\frac{7}{8}$	$12\frac{1}{8}$	$12\frac{1}{16}$	$12\frac{3}{8}$	3,479,952
1882	16,791,557	.41	6,949,756	9.9	309,696,500	$10\frac{1}{4}$	$10\frac{7}{16}$	$10\frac{1}{2}$	$11\frac{1}{8}$	4,576,150
1883	16,777,993	.34	5,713,200	9.0	250,594,750	$10\frac{3}{8}$	$10\frac{9}{16}$	$11\frac{1}{2}$	$11\frac{3}{4}$	3,725,145
1884	17,439,612	.33	5,706,165	9.2	253,993,385	$10\frac{7}{16}$	$11\frac{7}{16}$	$10\frac{11}{16}$	11	3,783,319
1885	18,300,865	.36	6,575,691	8.5	269,989,812	$9\frac{3}{16}$	$9\frac{7}{16}$	$9\frac{3}{16}$	$9\frac{5}{16}$	4,116,075
1886	18,454,603	.35	6,505,087	8.1	309,381,938	$9\frac{3}{16}$	$9\frac{9}{16}$	$10\frac{3}{4}$	$11\frac{7}{16}$	4,338,915
1887	18,641,067	.38	7,046,833	8.5	337,972,453	$10\frac{1}{2}$	$10\frac{5}{8}$	$9\frac{15}{16}$	$10\frac{1}{16}$	4,528,242
1888	19,058,591	.36	6,938,290	8.5	354,454,340	$9\frac{3}{4}$	$9\frac{7}{8}$	11	$11\frac{3}{16}$	4,769,633
1889	20,171,896	.36	7,311,322	8.3	402,951,814	$10\frac{1}{4}$	$10\frac{1}{4}$	$11\frac{15}{16}$	$12\frac{3}{4}$	4,943,600
1890	20,809,053	.42	8,652,597	8.6	369,568,858	$9\frac{3}{16}$	$9\frac{7}{16}$	$8\frac{7}{8}$	$8\frac{15}{16}$	5,814,717
1891	20,714,937	.44	9,035,379	7.3	326,513,298	$7\frac{3}{4}$	$8\frac{1}{16}$	$7\frac{1}{4}$	$7\frac{7}{16}$	5,870,440
1892	18,067,924	.37	6,700,365	8.4	262,252,286	$9\frac{3}{8}$	10	$7\frac{5}{8}$	$7\frac{13}{16}$	4,424,230
1893	19,525,000	.39	7,549,817	7.0	274,479,637	$7\frac{13}{16}$	$8\frac{1}{16}$	$7\frac{1}{8}$	$7\frac{3}{8}$	5,366,565
1894–1895	23,687,950	......	*a*9,901,251	......	*b*287,120,818	$5\frac{11}{16}$	$5\frac{13}{16}$	$6\frac{3}{4}$	$7\frac{3}{8}$	7,034,866
1895–1896	20,184,808	......	*a*7,161,094	......	*b*260,338,096	$8\frac{1}{4}$	$8\frac{9}{16}$	8	$8\frac{3}{8}$	4,670,453
1896–1897	23,273,209	......	*a*8,532,705	......	*b*291,811,564	$7\frac{1}{16}$	$7\frac{11}{16}$	$7\frac{5}{8}$	$7\frac{13}{16}$	6,207,510
1897–1898	24,319,584	......	*a*10,897,857	......	*b*319,491,412	$5\frac{13}{16}$	$5\frac{15}{16}$	$6\frac{5}{16}$	$6\frac{9}{16}$	7,725,572
1898–1899	24,967,295	......	*a*11,189,205	......	*b*305,467,041	$5\frac{5}{8}$	$5\frac{7}{8}$	$6\frac{1}{8}$	$6\frac{1}{4}$	7,575,838
1899–1900	23,403,153	......	*a*9,142,838	......	*b*334,847,868	$7\frac{1}{2}$	$7\frac{3}{4}$	9	$9\frac{7}{8}$	6,201,166
1900–1901	27,114,103	......	*a*10,401,453	......	*b*511,098,111	$9\frac{3}{4}$	$10\frac{5}{16}$	$8\frac{1}{16}$	$8\frac{5}{16}$	6,661,781
1901–1902	27,220,414	......	*a*10,662,995	......	*b*418,358,366	8	$8\frac{3}{4}$	$9\frac{3}{4}$	$9\frac{3}{4}$	7,001,558
1902–1903	25,758,139	......	*a*10,725,422	......	*b*458,051,005	$8\frac{1}{2}$	$8\frac{7}{8}$	......	......	7,086,086

a Commercial crop. *b* Value of commercial crop.

Cotton acreage from 1897–98 to 1902–3, inclusive.

States and Territories.	1897–98.	1898–99.	1899–1900.	1900–1901.	1901–2.	1902–3.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Virginia	50,612	51,162	35,302	30,572	35,145	36,843
North Carolina	1,302,437	1,311,708	1,219,888	1,091,034	1,112,260	1,075,743
South Carolina	2,074,778	2,353,213	2,212,020	2,195,252	2,248,569	2,205,016
Georgia	3,537,702	3,535,205	3,287,741	3,783,015	4,006,199	3,863,542
Florida	251,109	152,452	149,403	235,451	254,596	253,961
Alabama	2,709,460	3,003,176	2,883,049	3,403,746	3,642,964	3,501,614
Mississippi	2,778,610	2,900,298	2,784,286	3,194,795	3,193,570	3,183,989
Louisiana	1,245,399	1,281,691	1,179,156	1,480,781	1,586,124	1,617,586
Texas	7,164,175	6,991,904	6,642,309	7,178,915	7,656,312	7,640,531
Arkansas	1,619,785	1,876,467	1,726,350	1,742,787	1,854,482	1,901,758
Tennessee	967,077	896,722	734,415	662,612	737,337	754,600
Missouri	83,319	82,318	41,340	49,504	54,628	59,341
Oklahoma	216,664	215,893	208,553	255,446	306,750	358,391
Indian Territory	317,992	314,906	299,161	453,560	530,923	658,699
Utah	75	35	40	30	....	....
Kansas	285	8	414	311	380	122
Kentucky	105	137	70	328	175	2,367
Total	24,319,584	24,967,295	23,403,497	25,758,139	27,220,414	27,114,103

From the following table it will be seen that of the actual cotton crop of the year 1901–2, amounting to 9,966,478 bales, 115,550 bales were marketed prior to September 1, 1901, and were thus included in the commercial crop of the year 1900–1901, while 154,592 bales were still on hand at the termination of the cotton year, August 31, 1902, to be carried forward to the year 1902–3, thus leaving 9,696,336 bales of the growth of 1901–2 marketed that year. To this were added 528,900 bales of the growth of preceding years and 198,190 bales of the crop of 1902–3 marketed prior to September 1, 1902, making a total of 10,423,426 bales as delivered from plantations. There also entered into the commercial crop 172,226 bales of linters received from cotton-seed oil mills, and 67,343 bales of sample and waste cotton known to the trade as the city crop, which latter, being taken from bales already included in the commercial movement, is in reality counted twice.

Cotton production in the United States in 1901-2.

States and Territories.	Actual growth in year 1901-2. *a*	Cotton grown in preceding years and marketed in 1901-2. *a*	Cotton grown in 1902-3 and marketed prior to Sept. 1, 1902. *a*	Linters. *a*	Sample cotton rebaled. *a*	Cotton of the crop of 1901-2 marketed prior to Sept. 1, 1901. *a*	Cotton of the crop of 1901-2 carried forward to the year 1902-3. *a*	Commercial crop of the year 1901-2. *a*
Virginia	15,526	....	....	....	67	....	905	14,688
North Carolina	590,384	4,520	6,200	7,395	2,589	3,582	7,838	599,668
South Carolina	830,983	6,535	5,541	11,323	3,605	3,235	11,095	843,660
Georgia	1,444,675	124,815	41,435	23,730	6,268	25,584	17,147	1,598,192
Florida	51,282	....	474	296	209	575	1,184	50,502
Alabama	1,081,993	38,190	7,595	16,091	6,815	4,426	15,164	1,131,094
Mississippi	1,382,988	12,360	2,308	24,758	10,180	4,915	22,336	1,405,343
Louisiana	853,536	22,140	9,286	12,669	5,391	5,148	17,063	880,811
Texas	2,331,647	282,580	124,976	52,420	21,306	62,894	45,556	2,704,479
Arkansas	783,660	16,785	113	15,142	6,599	3,848	13,958	804,493
Tennessee	163,356	20,975	259	8,402	1,025	192	903	192,922
Missouri	23,977	....	....	....	193	51	195	23,924
Oklahoma	143,547	....	....	....	1,158	223	28	144,454
Indian Territory	268,682	....	....	....	1,938	877	1,220	268,523
Kansas	171	....	....	....	....	....	....	171
Kentucky	71	....	....	....	....	....	....	71
Total	9,966,478	528,900	198,190	172,226	67,343	115,550	154,592	10,662,995

a Commercial bales.

Prices of middling upland cotton in New Orleans, 1890-1903.

[In cents per pound.]

Year	January.		February.		March.		April.		May.		June.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1890	9 5/8	10 11/16	10 3/8	10 11/16	10 11/16	11	11	11 11/16	11 9/16	11 7/8	11 7/16	11 7/8
1891	8 15/16	9 5/16	8 3/4	9 1/16	8 5/8	8 3/4	8 5/16	8 11/16	8 5/16	8 3/8	7 7/8	8 1/4
1892	6 13/16	7 3/16	6 1/2	6 7/8	6 1/4	6 1/2	6 3/8	7	7	7 3/16	7 1/16	7 1/2
1893	9 1/4	9 5/8	8 13/16	9 1/4	8 5/16	9	7 7/16	8 3/16	7 1/4	7 5/8	7 5/16	7 7/8
1894	7 5/16	7 3/4	7 1/16	7 7/16	7 1/8	7 5/16	7	7 5/16	6 13/16	7 1/16	6 7/8	7 1/8
1895	5	5 3/16	5	5 3/16	5 1/16	5 7/8	5 3/4	6 3/8	6 3/16	7	6 5/8	7
1896	7 13/16	8	7 1/2	8	7 3/8	7 13/16	7 5/8	7 3/4	7 3/8	7 3/4	6 13/16	7 3/8
1897	6 7/8	7	6 11/16	7 3/16	6 15/16	7 3/16	6 15/16	7 9/16	7 5/16	7 9/16	7 3/8	7 5/8
1898	5 3/16	5 3/8	5 1/4	5 11/16	5 7/16	5 3/4	5 9/16	5 3/4	5 11/16	6 1/16	5 7/8	6 1/16
1899	5 3/16	5 3/4	5 3/4	6	5 11/16	6 1/16	5 5/8	5 3/4	5 11/16	5 7/8	5 1/2	5 3/4
1900	7 1/4	7 3/4	7 7/8	9	9	9 7/16	9 1/8	9 1/2	8 13/16	9 1/2	8 13/16	9 13/16
1901	9 5/16	9 11/16	9 1/16	9 5/16	7 15/16	9 1/16	8	8 5/16	7 9/16	8	7 3/4	8 7/16
1902	7 3/4	8	7 13/16	8 3/16	8 1/4	8 5/8	8 9/16	9 3/4	9 1/8	9 3/4	8 15/16	9 5/16
1903	8 7/16	8 7/8	8 7/8	9 7/8	9 9/16	9 7/8	9 3/4	10 3/16	10 3/16	11 11/16	11 11/16	13 5/8

Year.	July.		August.		September.		October.		November.		December.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High	Low.	High.	Low.	High.
1890	11 7/16	11 3/4	10 3/8	11 3/4	9 3/4	10 1/4	9 11/16	10 1/16	9 1/16	9 9/16	8 13/16	9 1/8
1891	7 3/4	7 15/16	7 5/8	8	8	8 1/2	7 15/16	8 3/8	7 3/8	7 7/8	7	7 1/2
1892	7	7 3/16	6 15/16	7 3/16	6 15/16	7 7/16	7 7/16	7 13/16	7 11/16	9 7/8	9 5/16	9 11/16
1893	7 7/16	7 3/4	6 13/16	7 5/8	7 5/16	8 3/16	7 5/8	8 1/8	7 7/16	7 3/4	7 1/8	7 9/16
1894	6 5/8	6 7/8	6 7/16	6 5/8	5 11/16	6 1/2	5 3/16	5 3/4	4 7/8	5 1/2	5 1/16	5 5/16
1895	6 1/2	6 3/4	6 9/16	7 11/16	7 9/16	8 3/4	8 5/16	9 3/16	8 1/16	8 5/8	7 3/4	8 3/16
1896	6 1/2	6 13/16	6 13/16	8	7 5/8	8 1/8	7 1/8	7 5/8	7 3/16	7 1/2	6 11/16	7 3/8
1897	7 11/16	7 13/16	7 1/16	7 11/16	6 1/16	7 1/16	5 1/2	6 1/8	5 1/4	5 1/2	5 1/4	5 3/8
1898	5 5/8	5 7/8	5 3/8	5 11/16	4 7/8	5 3/8	4 13/16	5	4 3/4	5 1/16	5	5 1/4
1899	5 5/8	5 3/4	5 3/4	5 15/16	5 3/4	6 1/2	6 3/4	6 15/16	6 7/8	7 7/16	7 3/16	7 1/2
1900	9 7/8	10 1/4	9 3/8	10 1/4	9 3/8	11 1/8	8 13/16	10 5/16	9	9 7/8	9 1/4	9 13/16
1901	8 1/8	8 7/16	8	8 15/16	7 15/16	8 5/8	7 7/16	8 5/16	7 1/4	7 7/16	7 3/4	8 1/16
1902	8 5/8	9 1/16	8 3/8	8 5/8	8 3/16	8 5/8	8	8 1/2	7 5/8	8	7 15/16	8 3/8
1903	12 5/8	13 5/8	12 1/2	13 1/4	9 3/4	12 1/2	9 1/8	10 1/4	10	11 3/16	11 1/2	13 5/8

Closing prices middling upland cotton per pound, in leading cities of the United States, 1898–1903.

Date.	New York.		New Orleans.		Memphis.		Galveston.		Savannah.		Charleston.		Wilmington.		Norfolk.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1898.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	5 7/8	5 15/16	5 3/16	5 3/8	5 5/16	5 3/8	5 7/16	5 9/16	5 1/8	5 1/4	5 3/16	5 5/16	5 3/8	5 7/16	5 7/16	5 1/2
February	5 15/16	6 5/16	5 1/4	5 11/16	5 5/16	5 3/4	5 1/2	6	5 3/16	5 15/16	5 1/4	5 3/4	5 3/8	5 3/4	5 1/2	5 15/16
March	6 1/16	6 5/16	5 7/16	5 3/4	5 1/2	5 13/16	5 5/8	6 1/16	5 9/16	5 3/4	5 1/2	5 3/4	5 3/4	6	5 3/4	6
April	6 3/16	6 7/8	5 9/16	5 13/16	5 5/8	6	5 3/4	5 7/8	5 9/16	5 7/8	5 9/16	5 13/16	5 5/8	6 1/4	5 13/16	6 3/16
May	6 5/16	6 9/16	5 11/16	6 1/16	5 3/4	6	5 11/16	6	5 11/16	6	5 3/4	5 3/4	6	6 1/4	6 1/8	6 3/8
June	6 5/16	6 9/16	5 15/16	6 1/16	5 7/8	6	5 13/16	6	5 3/4	6	6	6	5 7/8	6 1/8	6 3/16	6 3/8
July	6 1/16	6 1/4	5 5/8	5 15/16	5 3/4	5 7/8	5 11/16	5 13/16	5 5/8	5 3/4	5 1/2	5 1/2	5 3/8	5 7/8	5 7/8	6 1/8
August	5 3/4	6 1/8	5 3/8	5 11/16	5 3/8	5 3/4	5 7/16	5 11/16	5 1/8	5 11/16	5	5 1/2	5 1/4	5 5/8	5 5/8	5 7/8
September	5 5/16	5 13/16	4 7/8	5 3/8	4 7/8	5 5/16	4 7/8	5 7/16	4 3/4	5 3/16	4 3/4	5 1/8	4 7/8	5 1/4	5 1/8	5 5/8
October	5 5/16	5 1/2	4 7/8	5 1/4	4 7/8	5	4 7/8	5 1/16	4 5/8	4 13/16	4 11/16	4 7/8	4 7/8	5	5	5 1/8
November	5 5/16	5 3/4	4 3/4	5 1/16	4 7/8	5 3/16	4 7/8	5 1/4	4 1/2	4 7/8	4 9/16	4 15/16	4 3/4	5	4 15/16	5 1/4
December	5 5/8	5 7/8	5	5 1/4	5 1/4	5 5/8	5 1/4	5 1/2	4 7/8	5 1/8	4 15/16	5 1/4	5	5 3/8	5 1/4	5 7/16
1899.																
January	5 7/8	6 7/16	5 3/16	5 3/4	5 3/8	5 3/4	5 7/16	6 1/16	5 1/16	5 3/4	5 1/8	5 3/4	5 3/8	5 7/8	5 3/8	6
February	6 5/16	6 5/8	5 11/16	6	5 11/16	6 1/8	6	6 3/8	5 5/8	5 15/16	5 11/16	5 15/16	5 7/8	6	6	6 1/4
March	6 3/16	6 9/16	5 11/16	6 1/8	5 7/8	6 1/8	5 15/16	6 1/4	5 11/16	5 7/8	5 5/8	5 15/16	6	6	6	6 1/8
April	6 1/8	6 5/16	5 5/8	5 3/4	5 3/4	5 7/8	5 7/8	5 15/16	5 5/8	5 11/16	5 1/2	5 5/8	5 7/8	6	5 7/8	6
May	6 1/8	6 1/4	5 11/16	5 7/8	5 3/4	5 3/4	5 7/8	5 15/16	5 5/8	5 5/8	5 1/2	5 9/16	5 7/8	5 7/8	5 7/8	6
June	6 1/16	6 5/16	5 1/2	5 3/4	5 5/8	5 13/16	5 3/4	5 15/16	5 5/8	5 5/8	6 9/16	6 5/8	5 7/8	5 7/8	5 7/8	6 1/8
July	6 1/8	6 1/4	5 5/8	5 3/4	5 5/8	5 3/4	5 7/8	5 7/8	5 5/8	5 5/8	....	....	5 7/8	5 7/8	5 7/8	6
August	6 1/8	6 1/2	5 3/4	5 15/16	5 3/4	5 15/16	5 7/8	6 1/8	5 1/2	5 7/8	5 1/2	5 11/16	5 7/8	5 7/8	5 15/16	6 1/8
September	6 1/4	6 7/8	5 3/4	6 1/2	5 7/8	6 3/4	6 1/16	6 5/8	5 5/8	6 1/2	5 1/2	6 5/8	5 7/8	6 1/2	6	6 7/8
October	7 3/16	7 3/8	6 1/8	6 15/16	6 3/4	7 1/8	6 15/16	7 1/8	6 5/8	6 7/8	6 5/8	7	6 1/2	7 1/4	7 1/16	7 3/16
November	7 3/8	7 13/16	6 7/8	7 7/16	7	7 1/2	7 1/16	7 1/2	6 7/8	7 1/4	6 7/8	7 3/8	7 1/8	7 1/2	7 1/16	7 1/2
December	7 1/2	7 3/4	7 3/16	7 1/2	7 1/4	7 7/16	7 1/4	7 7/16	7 1/8	7 5/16	7 3/16	7 3/8	7	7 1/4	7 5/16	7 1/2
1900.																
January	7 1/4	8	7 1/4	7 3/4	7 3/8	7 11/16	7 1/4	7 11/16	7 5/16	7 5/8	7 1/4	7 5/8	7 1/4	7 1/2	7 7/16	7 7/8
February	8 7/8	9 5/16	7 7/8	8 7/8	7 11/16	8 3/4	7 3/4	8 13/16	7 11/16	8 15/16	7 5/8	8 3/4	7 1/2	8 3/4	7 7/8	9 1/8
March	9 7/16	9 7/8	9	9 7/16	8 7/8	9 7/16	9 1/8	9 3/8	9 1/16	9 1/2	9	9 1/2	9	9 1/2	9 1/4	9 7/8
April	9 9/16	9 7/8	9 1/8	9 1/2	9 1/4	9 3/8	9 1/4	9 7/16	9 3/8	9 7/16	9 1/4	9 3/8	9 1/4	9 1/2	9 1/2	9 5/8
May	9	9 7/8	8 13/16	9 1/2	8 3/4	9 7/16	8 7/8	9 7/16	9	9 7/16	9 5/16	9 3/8	9 1/4	9 1/4	9 1/4	9 5/8
June	8 13/16	10	8 13/16	9 3/16	8 5/8	9 5/8	8 1/2	9 3/8	8 3/4	9 1/4	....	....	....	....	8 3/4	9 5/8
July	9 13/16	10 1/4	9 7/8	10 1/4	9 5/8	10	9 3/8	9 1/2	9 5/16	9 7/8	9 1/2	9 5/8	....	....	9 3/4	10 1/16
August	9 1/2	10 1/4	9 1/2	10 1/4	9 1/2	9 3/4	8 7/8	9 9/16	9	9 3/4	8 5/8	9 1/2	....	....	9 1/4	10
September	9 5/8	11	9 1/2	11 1/8	9 5/16	11	9 1/4	10	9 1/16	10 3/4	8 7/8	10 3/4	9	10 3/4	9 3/8	11
October	9 7/16	11	8 13/16	10 1/4	8 7/8	10 1/4	8 13/16	10	8 13/16	10 1/16	8 3/4	10	9	10 1/4	9	10 5/16
November	9 9/16	10 1/4	9	9 7/8	8 15/16	10	9	9 3/4	8 15/16	9 3/4	9	9 11/16	9	9 3/8	9	9 13/16
December	9 3/4	10 5/16	9 1/4	9 13/16	9 3/8	9 13/16	9 1/4	9 11/16	9 1/16	9 11/16	9	9 5/8	9 1/4	9 3/8	9 1/4	9 3/4

1901.																
January	$9\frac{7}{8}$	12	$9\frac{5}{16}$	$9\frac{11}{16}$	9	$9\frac{5}{8}$	$9\frac{3}{8}$	$9\frac{11}{16}$	$9\frac{3}{8}$	$9\frac{5}{8}$	$9\frac{1}{4}$	$9\frac{5}{8}$	$9\frac{1}{4}$	$9\frac{1}{2}$	$9\frac{3}{8}$	$9\frac{11}{16}$
February	$9\frac{1}{16}$	10	$9\frac{1}{16}$	$9\frac{5}{16}$	$9\frac{1}{16}$	$9\frac{7}{16}$	$9\frac{1}{8}$	$9\frac{7}{16}$	9	$9\frac{3}{8}$	9	$9\frac{1}{8}$	9	$9\frac{1}{2}$	$9\frac{1}{8}$	$9\frac{7}{16}$
March	$8\frac{1}{8}$	$9\frac{15}{16}$	$7\frac{15}{16}$	$9\frac{1}{16}$	8	$9\frac{1}{8}$	8	$9\frac{1}{8}$	$7\frac{7}{8}$	9	$7\frac{3}{4}$	9	$7\frac{7}{8}$	9	8	$9\frac{1}{4}$
April	$8\frac{1}{4}$	$8\frac{9}{16}$	$8\frac{1}{16}$	$8\frac{5}{16}$	8	$8\frac{1}{4}$	$8\frac{1}{8}$	$8\frac{3}{8}$	$7\frac{15}{16}$	$8\frac{1}{8}$	$7\frac{7}{8}$	8	$7\frac{1}{2}$	$7\frac{7}{8}$	$8\frac{1}{16}$	$8\frac{1}{4}$
May	$8\frac{1}{16}$	$8\frac{5}{16}$	$7\frac{9}{16}$	8	$7\frac{9}{16}$	8	$7\frac{5}{8}$	$8\frac{1}{4}$	$7\frac{7}{16}$	$8\frac{1}{16}$	$7\frac{1}{2}$	8	$7\frac{3}{4}$	$7\frac{7}{8}$	$7\frac{5}{8}$	$8\frac{1}{16}$
June	$8\frac{1}{4}$	$8\frac{15}{16}$	$7\frac{3}{4}$	$8\frac{3}{8}$	$7\frac{5}{8}$	$8\frac{5}{16}$	$7\frac{13}{16}$	$8\frac{7}{16}$	$7\frac{1}{2}$	$8\frac{1}{8}$	$7\frac{1}{2}$	$8\frac{3}{4}$	$7\frac{3}{4}$	$7\frac{3}{4}$	$7\frac{3}{4}$	$8\frac{7}{16}$
July	$8\frac{1}{8}$	$8\frac{7}{8}$	$8\frac{1}{8}$	$8\frac{7}{16}$	8	$8\frac{5}{16}$	$8\frac{1}{8}$	$8\frac{1}{2}$	8	$8\frac{1}{4}$	$8\frac{1}{8}$	$8\frac{1}{4}$	$7\frac{3}{4}$	$8\frac{1}{4}$	$7\frac{3}{4}$	$8\frac{1}{2}$
August	8	$8\frac{5}{8}$	8	$8\frac{15}{16}$	8	$8\frac{3}{8}$	$8\frac{1}{16}$	$8\frac{15}{16}$	$7\frac{5}{8}$	$8\frac{3}{8}$	$7\frac{3}{4}$	$8\frac{1}{4}$	8	$8\frac{1}{4}$	$7\frac{13}{16}$	$8\frac{5}{8}$
September	$8\frac{3}{16}$	$8\frac{5}{8}$	$7\frac{15}{16}$	$8\frac{5}{8}$	$7\frac{13}{16}$	$8\frac{5}{8}$	$7\frac{15}{16}$	$8\frac{15}{16}$	$7\frac{5}{8}$	$8\frac{3}{8}$	$7\frac{5}{8}$	$8\frac{3}{8}$	8	$8\frac{1}{4}$	8	$8\frac{5}{8}$
October	7	$8\frac{9}{16}$	$7\frac{7}{16}$	$8\frac{5}{16}$	$7\frac{1}{2}$	$8\frac{5}{8}$	$7\frac{5}{8}$	$8\frac{3}{8}$	$7\frac{3}{16}$	8	$7\frac{3}{16}$	$8\frac{1}{8}$	$7\frac{3}{8}$	$8\frac{3}{8}$	$7\frac{3}{8}$	$8\frac{3}{16}$
November	$7\frac{13}{16}$	8	$7\frac{1}{2}$	$7\frac{7}{16}$	$7\frac{1}{2}$	$7\frac{5}{8}$	$7\frac{3}{8}$	$7\frac{5}{8}$	$7\frac{1}{8}$	$7\frac{5}{16}$	$7\frac{1}{8}$	$7\frac{3}{8}$	$7\frac{1}{8}$	$7\frac{3}{8}$	$7\frac{1}{4}$	$7\frac{1}{2}$
December	8	$8\frac{3}{4}$	$7\frac{3}{8}$	$8\frac{7}{16}$	$7\frac{5}{16}$	8	$7\frac{1}{2}$	$8\frac{1}{8}$	$7\frac{1}{4}$	$7\frac{15}{16}$	$7\frac{11}{16}$	8	$7\frac{1}{2}$	$7\frac{7}{8}$	$7\frac{1}{2}$	$8\frac{1}{16}$
1902.																
January	$8\frac{3}{16}$	$8\frac{9}{16}$	$7\frac{3}{4}$	8	7	$7\frac{15}{16}$	$7\frac{7}{8}$	8	$7\frac{3}{4}$	$7\frac{7}{8}$	$7\frac{3}{16}$	$7\frac{7}{8}$	$7\frac{3}{4}$	$7\frac{7}{8}$	$7\frac{13}{16}$	8
February	$8\frac{1}{4}$	$8\frac{13}{16}$	$7\frac{13}{16}$	$8\frac{3}{16}$	$7\frac{13}{16}$	$8\frac{1}{4}$	$7\frac{15}{16}$	$8\frac{5}{16}$	$7\frac{13}{16}$	$8\frac{5}{16}$	$7\frac{7}{8}$	$8\frac{5}{16}$	$7\frac{7}{8}$	$8\frac{1}{4}$	$7\frac{15}{16}$	$8\frac{1}{2}$
March	$8\frac{7}{8}$	$9\frac{3}{16}$	$8\frac{1}{4}$	$8\frac{5}{8}$	$8\frac{1}{4}$	$8\frac{3}{8}$	$8\frac{7}{16}$	$8\frac{5}{8}$	$8\frac{5}{16}$	$8\frac{5}{8}$	$8\frac{1}{4}$	$8\frac{5}{8}$	$8\frac{1}{4}$	$8\frac{5}{8}$	$8\frac{1}{2}$	$8\frac{13}{16}$
April	9	$9\frac{7}{8}$	$8\frac{9}{16}$	$9\frac{3}{4}$	$8\frac{1}{2}$	$9\frac{1}{2}$	$8\frac{5}{8}$	$9\frac{5}{8}$	$8\frac{9}{16}$	$9\frac{9}{16}$	$8\frac{3}{16}$	$9\frac{3}{8}$	$8\frac{5}{8}$	$9\frac{3}{8}$	$8\frac{3}{4}$	$9\frac{3}{4}$
May	$9\frac{3}{8}$	$9\frac{3}{4}$	$9\frac{1}{8}$	$9\frac{3}{4}$	9	$9\frac{1}{2}$	$9\frac{3}{16}$	$9\frac{5}{8}$	$9\frac{3}{16}$	$9\frac{1}{2}$	$9\frac{1}{4}$	$9\frac{3}{8}$	9	$9\frac{1}{2}$	$9\frac{3}{16}$	$9\frac{3}{4}$
June	$9\frac{1}{4}$	$9\frac{7}{16}$	$8\frac{15}{16}$	$9\frac{5}{16}$	$8\frac{13}{16}$	$9\frac{1}{16}$	$8\frac{15}{16}$	$9\frac{1}{4}$	9	$9\frac{3}{16}$	$8\frac{3}{4}$	$8\frac{3}{4}$	9	$9\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{4}$
July	$8\frac{15}{16}$	$9\frac{3}{8}$	$8\frac{5}{8}$	$9\frac{1}{16}$	$8\frac{13}{16}$	9	$8\frac{3}{4}$	$8\frac{15}{16}$	$8\frac{3}{4}$	$8\frac{7}{8}$	$8\frac{5}{8}$	$8\frac{5}{8}$	$8\frac{3}{4}$	9	9	$9\frac{1}{8}$
August	$8\frac{7}{8}$	9	$8\frac{5}{16}$	$8\frac{5}{8}$	$8\frac{1}{2}$	$8\frac{13}{16}$	$8\frac{7}{16}$	$8\frac{3}{4}$	$8\frac{1}{8}$	$8\frac{3}{4}$	$8\frac{3}{16}$	$8\frac{1}{4}$	$8\frac{1}{2}$	$8\frac{3}{4}$	$8\frac{3}{4}$	$9\frac{1}{16}$
September	$8\frac{7}{8}$	$9\frac{1}{8}$	$8\frac{3}{16}$	$8\frac{5}{8}$	$8\frac{1}{4}$	$8\frac{1}{2}$	$8\frac{1}{4}$	$8\frac{5}{8}$	$8\frac{1}{8}$	$8\frac{7}{16}$	$8\frac{1}{16}$	$8\frac{3}{8}$	$8\frac{3}{8}$	$8\frac{1}{2}$	$8\frac{1}{2}$	9
October	$8\frac{9}{16}$	$8\frac{15}{16}$	8	$8\frac{1}{2}$	$7\frac{15}{16}$	$8\frac{7}{16}$	$8\frac{3}{16}$	$8\frac{9}{16}$	$7\frac{7}{8}$	$8\frac{1}{4}$	$7\frac{7}{8}$	$8\frac{1}{4}$	$8\frac{1}{8}$	$8\frac{3}{8}$	$8\frac{1}{8}$	$8\frac{9}{16}$
November	$8\frac{5}{16}$	$8\frac{5}{8}$	$7\frac{5}{8}$	8	$7\frac{5}{8}$	8	$7\frac{3}{4}$	$8\frac{3}{16}$	$7\frac{9}{16}$	$7\frac{15}{16}$	$7\frac{9}{16}$	8	$7\frac{3}{4}$	$8\frac{1}{8}$	$7\frac{3}{4}$	$8\frac{3}{16}$
December	$8\frac{1}{2}$	$8\frac{7}{8}$	$7\frac{15}{16}$	$8\frac{3}{8}$	8	$8\frac{5}{16}$	$8\frac{1}{8}$	$8\frac{1}{2}$	$7\frac{7}{8}$	$8\frac{1}{4}$	$7\frac{7}{8}$	$8\frac{1}{4}$	$7\frac{3}{4}$	$8\frac{1}{8}$	$8\frac{1}{16}$	$8\frac{1}{2}$
1903.																
January	8.85	9.05	$8\frac{7}{16}$	$8\frac{7}{8}$	$8\frac{1}{2}$	$8\frac{3}{4}$	$8\frac{5}{8}$	$8\frac{15}{16}$	$8\frac{3}{8}$	$8\frac{3}{4}$	$8\frac{1}{4}$	$8\frac{5}{8}$	$8\frac{1}{4}$	$8\frac{1}{2}$	$8\frac{5}{8}$	9
February	9.00	10.25	$8\frac{7}{8}$	$9\frac{7}{8}$	$8\frac{3}{4}$	$9\frac{7}{8}$	$8\frac{15}{16}$	$10\frac{1}{16}$	$8\frac{3}{4}$	$9\frac{7}{8}$	$8\frac{5}{8}$	$9\frac{3}{4}$	$8\frac{1}{2}$	$9\frac{3}{4}$	9	10
March	9.90	10.45	$9\frac{9}{16}$	$9\frac{7}{8}$	$9\frac{11}{16}$	$9\frac{15}{16}$	$9\frac{7}{8}$	$10\frac{1}{16}$	$9\frac{3}{8}$	$9\frac{7}{8}$	$9\frac{1}{2}$	$9\frac{3}{4}$	$9\frac{1}{2}$	$9\frac{3}{4}$	$9\frac{3}{4}$	10
April	9.90	10.75	$9\frac{3}{4}$	$10\frac{3}{16}$	$9\frac{3}{4}$	10	$9\frac{7}{8}$	$10\frac{1}{8}$	$9\frac{5}{8}$	10	$9\frac{1}{2}$	10	$9\frac{1}{2}$	$9\frac{3}{4}$	10	$10\frac{1}{2}$
May	10.75	12.15	$10\frac{3}{16}$	$11\frac{11}{16}$	10	$11\frac{3}{8}$	$10\frac{1}{8}$	$11\frac{1}{2}$	10	$11\frac{1}{4}$	10	11	10	$10\frac{1}{2}$	$10\frac{3}{8}$	$11\frac{3}{8}$
June	11.50	13.35	$11\frac{11}{16}$	$13\frac{5}{8}$	$11\frac{3}{8}$	$13\frac{5}{16}$	$11\frac{7}{16}$	$12\frac{3}{4}$	$11\frac{1}{4}$	$12\frac{1}{2}$	Nominal.	11	Nominal.	$10\frac{1}{2}$	$11\frac{3}{8}$	13
July	11.60	13.50	$12\frac{5}{8}$	$13\frac{5}{8}$	$12\frac{7}{16}$	$13\frac{5}{16}$	12	$12\frac{3}{4}$	$12\frac{1}{4}$	$13\frac{1}{8}$	Nominal.		Nominal.		12	13
August	12.75	12.75	$12\frac{1}{2}$	$13\frac{1}{4}$	$12\frac{7}{16}$	$12\frac{15}{16}$	12	$12\frac{1}{8}$	$12\frac{1}{2}$	$13\frac{1}{8}$	$12\frac{1}{4}$	$12\frac{1}{4}$	Nominal.		$12\frac{1}{2}$	$12\frac{1}{2}$
September	11.25	13.00	$9\frac{3}{4}$	$12\frac{1}{2}$	$9\frac{3}{4}$	$12\frac{9}{16}$	10	$12\frac{1}{8}$	$9\frac{7}{16}$	$12\frac{1}{2}$	$9\frac{1}{2}$	$11\frac{7}{8}$	$9\frac{1}{2}$	$11\frac{1}{4}$	$9\frac{3}{4}$	$12\frac{1}{2}$
October	9.50	10.60	$9\frac{1}{8}$	$10\frac{1}{4}$	$9\frac{1}{2}$	$10\frac{1}{8}$	$9\frac{5}{16}$	$10\frac{3}{16}$	$9\frac{1}{16}$	$10\frac{1}{4}$	9	10	9	$10\frac{1}{8}$	$9\frac{1}{4}$	$10\frac{3}{16}$
November	10.50	11.65	10	$11\frac{3}{16}$	$10\frac{1}{16}$	$11\frac{1}{8}$	$10\frac{1}{8}$	$11\frac{3}{16}$	$10\frac{1}{8}$	$11\frac{1}{8}$	10	$10\frac{7}{8}$	10	11	$10\frac{1}{4}$	$11\frac{3}{8}$
December	11.95	14.10	$11\frac{1}{2}$	$13\frac{5}{8}$	$11\frac{1}{4}$	$13\frac{1}{2}$	$11\frac{7}{16}$	$13\frac{3}{8}$	$11\frac{3}{8}$	$13\frac{3}{8}$	11	$13\frac{1}{2}$	11	$12\frac{3}{4}$	$11\frac{3}{4}$	$13\frac{3}{4}$

TOBACCO.

Acreage, production, and value of tobacco in the United States in 1903.

State.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*
New Hampshire	132	1,590	209,880	13.0	27,284
Vermont	189	1,800	340,200	12.0	40,824
Massachusetts	4,993	1,400	6,990,200	12.0	838,824
Connecticut	13,234	1,600	21,174,400	15.5	3,282,032
New York	7,960	1,125	8,955,000	8.0	716,400
Pennsylvania	15,887	1,416	22,495,992	7.3	1,642,207
Maryland	33,059	650	21,488,350	5.5	1,181,859
Virginia	162,300	745	120,913,500	6.1	7,375,724
North Carolina	214,878	627	134,728,506	6.3	8,487,896
South Carolina	40,149	610	24,490,890	5.1	1,249,035
Georgia	2,030	640	1,299,200	15.0	194,880
Florida	3,726	700	2,608,200	32.0	834,624
Alabama	629	405	254,745	16.0	40,759
Mississippi	168	502	84,336	16.0	13,494
Louisiana	91	375	34,125	20.0	6,825
Texas	237	650	154,050	20.0	30,810
Arkansas	1,222	646	789,412	12.0	94,729
Tennessee	71,198	700	49,838,600	7.5	3,737,895
West Virginia	4,395	640	2,812,800	6.2	174,394
Kentucky	338,304	790	267,260,160	6.2	16,570,130
Ohio	60,431	845	51,064,195	7.2	3,676,622
Michigan	305	750	228,750	8.0	18,300
Indiana	7,096	783	5,556,168	6.2	344,482
Illinois	1,298	655	850,190	6.1	51,862
Wisconsin	51,812	1,350	69,946,200	6.8	4,756,342
Missouri	2,012	698	1,404,376	9.0	126,394
United States	1,037,735	786.3	815,972,425	6.8	55,514,627

HOPS.

Wholesale prices of hops per pound in leading cities of the United States, 1899–1903.

Date.	New York. Choice State. Low.	New York. Choice State. High.	Cincinnati. Choice. Low.	Cincinnati. Choice. High.	Chicago. Pacific coast, common to choice. Low.	Chicago. Pacific coast, common to choice. High
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	18	18	19	19	15	18
February	18	18	18	19	12	18
March	17	18	18	19	13	18
April	15	17	18	18½	13	18
May	16	16	16½	18	12	18
June	15	16	16	18	12	18
July	15	16	16	18	12	18
August	14	15	16	17	12	18
September	12	13	16	16	12½	16
October	13	15	13	13	9	16
November	13	14	13½	13½	9	13
December	12½	14	13	13	7	13
1900.						
January	12½	13½	13	13	9	10
February	12½	13½	12½	12½	9	10
March	12½	13½	12½	12½	9	10
April	12½	13½	12½	12½	9	10
May	12½	14	10	10	10	11
June	13	14	10	10	6½	10
July	13	14	10	10	6½	11
August	13	15	10	10	6¾	11
September	13	15	16½	16½	8	11
October	17	21	16½	16½	17	18
November	20	21	17½	17½	17	18
December	18	21	18	18	17	18

Wholesale prices of hops per pound in leading cities of the United States, etc.—Continued.

Date.	New York. Choice State.		Cincinnati. Choice.		Chicago. Pacific coast, common to choice.	
	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	17	20	17¾	17¾	17	18
February	....	....	17¾	17¾	17	18
March	18	20	17¾	17¾	18	19
April	18	20	17¾	17¾	18	19
May	17½	20	17⅞	17⅞	18	19
June	17½	18	17¾	17¾	17	18
July	16	18	17⅞	17⅞	17	18
August	14	17	17⅜	17⅜	15	16
September	13	16	17¼	17¼	14	15
October	14	15½	14	14	12½	14
November	14	15½	13¾	13¾	12½	14
December	14	15½	14	14	13	15
1902.						
January	14	16	14½	14½	12½	14
February	14½	18	15½	15½	15	16
March	17	19	17½	17½	13	16½
April	18	20	18½	18½	15	18
May	19	22	19½	19½	15	20
June	20½	24	21½	21½	15	20
July	22	26	23	23	20	22
August	24½	28	25	25	22	25
September	26	28	26½	26½	25	26
October	32	37	29½	29½	26	29
November	35	38	30	30	26	30
December	35	38	30	30	29	31
1903.					Good to choice.	
January	35	37	29	29	27	31
February	33	37	29	29	27	31
March	30	35	29½	29½	25	29
April	23	30	25	25	20	25
May	23	24	25	25	20	24
June	22½	24	24	24	22	24
July	20½	23½	24	24	19	22
August	20½	26	24	24	21	25
September	24½	30	25	25	26	28
October	30	33	26	26	20	27
November	30	32	26	26	24	26
December	30	35	27	27	24	27

FLAXSEED.

Flax crop of countries named, 1900–1902.

Country.	Seed. 1900.	Seed. 1901.	Seed. 1902.	Fiber. 1900.	Fiber. 1901.	Fiber. 1902.
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
United States	a 18,000,000	a 25,000,000	29,285,000	....	....	....
Manitoba	169,000	275,000	582,000	....	....	....
Mexico	197,000	165,000	152,000	....	....	....
Argentina	8,865,000	15,352,000	14,371,000	....	....	....
Total America	27,231,000	40,792,000	44,390,000	....	....	....
Ireland	....	....	....	22,801,000	14,868,000	25,182,000
Sweden	63,000	60,000	a 60,000	b 3,162,000	b 3,162,000	b 3,162,000
Netherlands	353,000	b 248,000	b 248,000	15,106,000	b 12,056,000	b 12,056,000
Belgium c	402,000	402,000	402,000	37,832,000	37,832,000	37,832,000
France	493,000	611,000	a 483,000	42,804,000	54,683,000	a 41,774,000
Italy d	....	....	....	41,917,000	41,917,000	41,917,000
Austria	895,000	1,131,000	1,034,000	110,954,000	122,267,000	113,508,000
Hungary	165,000	162,000	a 162,000	13,436,000	13,461,000	a 13,500,000
Croatia-Slavonia	28,500	23,000	a 23,000	8,555,000	8,684,000	....
Total Austria-Hungary	1,088,500	1,316,000	1,219,000	132,945,000	144,412,000	127,008,000

a Commercial estimate. b Average, 1898–1900. c Average, 1897–1899. d Average, 1892–1895.

Flax crop of countries named, 1900-1902—Continued.

Country.	Seed.			Fiber.		
	1900.	1901.	1902.	1900.	1901.	1902.
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
Roumania	260,000	554,000	1,005,000	610,000	1,431,000	4,484,000
Bulgaria [a]	23,000	23,000	23,000	2,116,000	2,116,000	2,116,000
Servia [b]	11,000	11,000	11,000	917,000	917,000	917,000
Russia [c]	20,670,000	15,227,000	20,173,000	1,015,718,000	728,044,000	1,165,098,000
Total Europe	23,363,500	18,452,000	23,624,000	1,315,931,000	1,041,441,000	1,461,546,000
British India	11,827,000	13,041,000	13,705,000			
Algeria [d]	10,000	10,000	10,000			

RECAPITULATION.

America	27,231,000	40,792,000	41,390,000			
Europe	23,363,500	18,452,000	23,624,000	1,315,931,000	1,041,441,000	1,461,546,000
British India	11,827,000	13,041,000	13,705,000			
Algeria	10,000	10,000	10,000			
Total	62,431,500	72,295,000	81,729,000	1,315,931,000	1,041,441,000	1,461,546,000

[a] Average, 1897-1899. [b] 1897 figures. [c] Includes Poland. [d] Commercial estimate.

Acreage, production, and value of flaxseed in the United States in 1903.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Wisconsin	38,950	12.3	479,085	92	440,758
Minnesota	607,425	9.9	6,013,508	83	4,991,212
Iowa	92,625	10.0	926,250	86	796,575
Missouri	55,845	6.2	346,239	84	290,841
Kansas	148,356	6.0	890,136	79	703,207
Nebraska	18,125	10.4	188,500	86	162,110
South Dakota	371,925	10.5	3,905,212	80	3,124,170
North Dakota	1,814,400	7.3	13,245,120	81	10,728,547
Montana	12,625	14.0	176,750	60	106,050
Idaho	34,845	15.3	533,128	85	453,159
Oregon	2,277	13.4	30,512	106	32,343
California	1,111	10.0	11,110	97	10,777
Oklahoma	27,720	18.0	498,960	80	399,168
Indian Territory	7,000	8.0	56,000	94	52,640
United States	3,233,229	8.4	27,300,510	81.7	22,291,557

Monthly average prices of flaxseed in Chicago.[a]

[Cents per bushel.]

Month.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	95¾	112¾	137¾	140¾	91¼	75⅝	124	115¼	152	166½	165½	119
February	95⅝	120	138½	141¼	90¾	75¾	126	117	159	168	168½	117
March	99	119¼	134½	140	88	78¾	120⅝	119½	162½	157½	168½	111½
April	97	114½	126	140½	90¼	75¾	124	118½	170½	161	172½	109
May	102⅜	107¾	131½	147¾	86	77⅞	131	109¾	178	169¼	168½	112¾
June	104¼	109	138¾	149¾	79¼	77½	113	105¼	177	179	165	106
July	101¾	107	128¼	133	73	83	96¾	100¾	165	184½	155	96¼
August	102¼	94⅜	125¾	107¾	68⅜	103⅞	89	108¼	141	162½	146	99
September	106¼	101¾	136	97⅜	70⅞	103¼	89¾	112¾	150½	152	135¾	101½
October	109⅝	102	145	94¼	74¼	99¼	98⅛	123¼	166¾	149½	121½	96¼
November	109	108¾	146½	92⅛	75⅛	106¼	101¾	133⅜	172	146¼	118	95
December	109¼	128¼	145½	93	75⅛	113¼	108⅜	145	162¼	149¾	119½	96½
Yearly average	102⅝	110½	136	123⅛	80¼	89⅛	110¼	117⅜	163 1/24	162⅛	150⅜	105

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

Wholesale prices of flaxseed per bushel in leading cities of the United States, 1899–1903.

Date.	St. Louis. Prime. Low.	St. Louis. Prime. High.	Cincinnati. Low.	Cincinnati. High.	Chicago. No. 1. Low.	Chicago. No. 1. High.	Milwaukee. Low.	Milwaukee. High.	Duluth. Low.	Duluth. High.
1899.										
January	$1.08	$1.13½	$0.90	$0.90	$1.10½	$1.20	$1.15	$1.20	$1.11	$1.16½
February	1.11	1.12½	.90	.90	1.13½	1.20½	1.18	1.20½	1.15	1.18
March	1.10	1.17	.90	1.00	1.14	1.25	1.18	1.24½	1.16	1.21
April	1.10	1.16	1.00	1.00	1.12	1.25	1.17	1.25	1.14¼	1.20
May	.98	1.12½	.90	1.00	1.02	1.17½	1.03½	1.17½	.99½	1.11
June	.95	1.00	.90	.90	1.00½	1.10	1.03	1.09	.90	1.07
July	.93	.98	.90	.90	.97	1.04½	.99	1.05	.99	1.02
August	.93	1.14½	.90	.90	.96½	1.20	1.00	1.20	1.00	1.00
September	1.02	1.15	.90	.90	1.04½	1.21	1.06	1.20	1.02	1.12½
October	1.12	1.28½	.90	1.00	1.14	1.32½	1.14	1.32½	1.11	1.27
November	1.26	1.30	1.00	1.00	1.27½	1.39¼	1.26½	1.39	1.23	1.38
December	1.34	1.46	1.00	1.00	1.39	1.51	1.39	1.52	1.30	1.42
1900.										
January	1.45	1.50	1.00	1.00	1.48	1.56	1.42	1.56	1.40	1.50
February	1.52	1.58	1.00	1.00	1.58	1.60	1.50	1.60	1.51	1.51¼
March	1.57	1.62	1.00	1.00	1.60	1.65	1.45	1.65	1.56	1.64
April	1.62	1.70	1.00	1.20	1.65	1.75	1.61½	1.73	1.64	1.73
May	1.62	1.65	1.20	1.20	1.76	1.80	1.65	1.80	1.70	1.80
June	1.55	1.58	1.20	1.30	1.74	1.80	1.72½	1.80	1.80	1.80
July	1.35	1.60	1.20	1.30	1.50	1.80	1.42	1.80	1.40	1.80
August	1.25	1.45	1.20	1.20	1.32	1.50	1.30	1.42	1.28½	1.41
September	1.42	1.56½	1.20	1.30	1.41½	1.59½	1.42½	1.75	1.43	1.59
October	1.46	1.75	1.30	1.30	1.47½	1.86	1.48½	1.86	1.48½	1.87
November	1.50	1.78	1.30	1.30	1.60	1.84	1.60	1.82	1.59½	1.85½
December	1.62	1.62	1.30	1.45	1.53½	1.71	1.54	1.68	1.60	1.80½
1901.										
January	1.50	1.72	1.30	1.45	1.56	1.77	1.45	1.76	1.57	1.73
February	1.58	1.72	1.30	1.50	1.60	1.76	1.60	1.75	1.59	1.72½
March	1.50	1.60	1.35	1.50	1.52	1.63	1.45	1.63½	1.53½	1.61
April	1.49	1.52	1.20	1.50	1.52	1.70	1.45	1.70	1.54½	1.76½
May	1.56	1.67	1.20	1.20	1.64½	1.74	1.55	1.75	1.67	1.78
June	1.67	1.68	1.20	1.30	1.70	1.88	1.35	1.88	1.65	1.88
July	1.50	1.65	1.30	1.30	1.79	1.90	1.75	1.88	1.75	1.88
August	1.37	1.65	1.30	1.40	1.40	1.85	1.48	1.83	1.44	1.75
September	1.37	1.38	1.25	1.35	1.38	1.66	1.40	1.65	1.39	1.62
October	1.38	1.48	1.25	1.25	1.41	1.58	1.44	1.63	1.38	1.54
November	....	....	1.25	1.30	1.40	1.52½	1.40	1.52½	1.34¼	1.49¼
December	....	....	1.30	1.30	1.38½	1.61	1.39	1.61	1.34½	1.55½
1902.										
January	....	....	1.30	1.40	1.58	1.73	1.61	1.73	1.56½	1.71½
February	....	....	1.30	1.40	1.63	1.74	1.66	1.73	1.65	1.72
March	....	....	1.30	1.40	1.63	1.74	1.68	1.74	1.65	1.74
April	....	....	1.30	1.40	1.65	1.80	1.74	1.80	1.72	1.78
May	1.50	1.65	1.30	1.40	1.58	1.79	1.76	1.79	1.70	1.77
June	1.50	1.50	1.25	1.35	1.54	1.76	1.73	1.76	1.60	1.76½
July	1.41	1.50	1.30	1.40	1.36	1.74	1.43	1.74	1.35	1.66
August	1.32½	1.45	1.25	1.30	1.37	1.55	1.40	1.55	1.35	1.50
September	1.22	1.38	1.25	1.25	1.25½	1.46	1.25	1.45	1.24½	1.47
October	1.12	1.25	1.25	1.25	1.15	1.28	1.19	1.28	1.15¼	1.27¾
November	1.11	1.14½	1.25	1.25	1.13	1.23	1.18	1.23	1.15½	1.20
December	1.11	1.14	1.25	1.25	1.14	1.25	1.20	1.25	1.16	1.21½
1903.										
January	1.12	1.17	1.30	1.30	1.14	1.24	1.21	1.24	1.14½	1.20
February	1.10	1.14	1.30	1.30	1.12	1.22	1.16	1.22	1.11¾	1.16½
March	1.05	1.12	1.30	1.30	1.06	1.17	1.00	1.17	1.07¾	1.13½
April	1.05	1.08	1.10	1.30	1.06	1.12	1.09	1.11½	1.08¾	1.11
May	1.07	1.17	1.00	1.10	1.08	1.17½	1.11	1.17½	1.10¼	1.16
June	.95	1.08	1.00	1.00	.98	1.14	1.01½	1.14	.99½	1.13
July	.91	.96	1.00	1.00	.90	1.02½	.95½	1.02½	.95	1.00¾
August	.91	1.00	1.00	1.00	.93	1.05	.97	1.05	.96¾	1.01½
September	.92	1.00	1.00	1.00	.94	1.09	.99	1.09	.99	1.09
October	.86	.93	1.00	1.00	.89	1.03½	.94½	1.04	.92	1.02¾
November	.86	.89	1.00	1.00	.90	1.00	.94	1.00	.93½	1.00
December	.87½	.90½	1.00	1.00	.90½	1.02½	.97½	1.01½	.95¾	1.00

SUGAR.

Sugar crop of the countries named, 1899–1900 to 1903–1904.

[In tons of 2,240 pounds.]

Country.	1899-1900.	1900-1901.	1901-1902.	1902-1903.	1903-1904.
CANE SUGAR.					
United States:					
Louisiana	147,164	270,338	310,000	300,000	215,000
Porto Rico	35,000	80,000	85,000	85,000	126,000
Hawaiian Islands	258,521	321,461	317,509	391,062	393,000
Cuba, crop	308,543	635,856	850,181	998,878	1,130,000
British West Indies:					
Trinidad, exports	42,210	52,673	51,077	45,000	49,000
Barbados, exports	50,000	55,360	43,750	33,000	58,000
Jamaica	27,000	17,059	15,843	18,772	17,000
Antigua and St. Kitts	18,000	21,579	19,000	18,000	19,000
French West Indies:					
Martinique, exports	30,000	39,750	34,942	29,035	25,000
Gaudeloupe	40,000	39,000	41,000	38,000	40,000
Danish West Indies:					
St. Croix	12,020	13,000	13,000	13,000	13,000
Haiti and Santo Domingo	45,000	45,000	45,000	45,000	45,000
Lesser Antilles (not named above)	8,000	15,000	15,000	12,000	13,000
Mexico	78,000	95,000	103,110	112,679	120,000
Central America:					
Gautemala	12,000	9,000	10,000	10,000	10,000
San Salvador	5,000	5,000	5,000	5,000	5,000
Nicaragua	4,000	3,500	4,500	4,500	4,000
Costa Rica	1,000	4,000	4,000	4,000	4,000
South America:					
British Guiana (Demerara), exports	90,079	84,559	123,967	121,570	125,000
Dutch Guiana (Surinam)	9,600	13,000	12,750	13,046	13,000
Venezuela	2,000	3,000	3,000	3,000	3,000
Peru, exports	100,381	135,000	138,000	140,000	140,000
Argentina	91,507	114,252	135,000	130,000	130,000
Brazil	322,000	308,011	349,088	187,500	227,000
Total in America	1,737,025	2,380,398	2,729,717	2,758,042	2,924,000
Asia:					
British India, exports	10,000	15,000	15,000	15,000	15,000
Java, crop	721,993	709,928	767,130	842,812	885,561
Philippine Islands, exports	62,785	55,400	78,637	90,000	100,000
Total in Asia	794,778	780,328	860,767	947,812	1,000,561
Australia and Polynesia:					
Queensland	124,070	92,554	120,858	76,626	100,500
New South Wales	15,500	19,000	18,000	21,000	20,000
Fiji Islands, exports	31,000	33,000	31,000	35,500	50,000
Total Australia and Polynesia	170,570	144,554	169,858	133,126	170,500
Africa:					
Egypt	98,500	94,880	96,200	90,000	90,000
Mauritius	157,025	175,267	147,828	150,349	175,000
Reunion	35,000	35,000	35,000	35,000	35,000
Total in Africa	290,525	305,147	279,028	275,349	300,000
Europe:					
Spain	33,215	28,000	28,000	28,000	28,000
Total cane-sugar production (Willett & Gray)	3,026,113	3,638,427	4,067,370	4,142,329	4,423,061
BEET SUGAR.					
Europe beet-sugar production (Licht):					
Germany	1,798,631	1,984,187	2,304,923	1,762,461	1,950,000
Austria	1,108,007	1,094,043	1,301,549	1,057,692	1,175,000
France	977,850	1,113,893	1,123,533	833,210	780,000
Russia	905,737	918,838	1,098,983	1,256,311	1,200,000
Belgium	302,865	333,119	334,960	215,000	210,000
Holland	171,029	178,081	203,172	102,411	125,000
Other countries	253,929	367,919	393,236	325,082	410,000
Total in Europe	5,518,048	5,990,080	6,760,356	5,552,167	5,850,000

Sugar crop of the countries named, 1899–1900 to 1903–1904—Continued.

Country.	1899–1900.	1900–1901.	1901–1902.	1902–1903.	1903–1904.
BEET SUGAR—continued.					
United States beet-sugar production (Willett & Gray):					
California	37,938	25,451	62,723	71,120	60,608
Nebraska	4,591	4,406	6,660	9,430	8,669
Utah	8,574	7,630	12,748	16,978	20,670
New Mexico	446	....	....	....	....
New York	1,607	3,669	4,049	2,799	4,479
Michigan	14,699	23,533	46,692	48,848	57,064
Minnesota	2,053	1,186	2,455	3,054	3,125
Oregon	982	888	1,250	2,025	1,250
Illinois	804	1,150	....	....	....
Colorado	804	5,982	19,977	34,623	39,566
Washington	446	625	857	1,641	2,213
Ohio	....	1,339	3,126	1,473	2,009
Wisconsin	....	....	2,589	3,463	4,911
Idaho	....	....	....	....	3,571
Total United States	72,944	75,859	163,126	195,463	208,135
Total cane and beet sugar	8,624,105	9,704,366	10,990,852	9,889,959	10,481,196

Quantity and value of sugar imported into the United States from the principal sources of supply during each fiscal year, from 1899 to 1903, inclusive.

QUANTITY.

Countries from which imported.	Annual average, 1899–1903.	Year ended June 30— 1899.	1900.	1901.	1902.	1903.	Per cent in 1903.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cuba	1,169,823,791	663,543,657	705,456,230	1,099,404,363	984,216,925	2,396,497,779	56.84
Dutch East Indies	891,019,316	986,438,330	1,162,202,854	777,986,990	636,710,315	891,758,090	21.15
British West Indies	217,585,603	267,565,738	200,479,351	232,989,234	194,969,474	191,924,220	4.55
British Guiana	164,959,674	138,152,464	149,715,600	183,331,202	181,237,759	172,361,345	4.09
Santo Domingo	113,236,435	112,213,037	122,206,692	107,193,244	111,580,425	112,988,775	2.68
Germany	456,911,170	667,127,773	590,984,996	716,824,596	217,872,627	91,745,860	2.18
Peru	89,253,270	50,080,303	75,155,975	129,534,403	102,647,624	88,848,044	2.11
Brazil	169,637,625	41,222,162	89,684,600	293,327,013	349,794,460	74,159,889	1.76
Egypt	80,250,467	141,940,690	74,015,702	63,389,981	59,557,384	62,348,580	1.48
Danish West Indies	24,167,441	22,711,543	21,664,980	19,217,052	16,037,682	41,205,950	.98
Austria-Hungary	95,875,832	69,397,343	96,130,457	161,174,865	111,818,771	40,857,724	.97
Philippine Islands	27,201,298	51,625,280	49,490,542	4,693,333	11,424,000	18,773,333	.44
Dutch Guiana	19,607,383	38,124,370	13,265,520	14,063,215	16,861,587	15,722,225	.37
Canada	2,603,948	2,020,001	878,778	1,399,269	2,436,647	6,285,045	.15
Guatemala	3,221,037	4,477,566	3,126,580	1,734,044	4,251,269	2,515,727	.06
Mexico	1,818,376	3,088,609	1,892,029	1,358,503	338,368	2,414,373	.06
Nicaragua	1,444,650	406,252	719,107	2,784,515	1,297,904	2,015,473	.05
Chinese Empire	5,285,750	10,758,164	4,606,743	7,914,450	2,397,107	752,285	.02
Salvador	1,601,259	2,471,012	61,700	992,150	3,738,472	742,963	.02
Netherlands	8,308,752	6,894,728	153,860	25,327,230	8,967,942	200,000	
Hongkong	2,205,362	5,084,695	2,419,268	2,536,672	846,618	139,555	
United Kingdom	10,915,768	16,685,790	9,375,569	17,272,407	11,125,336	119,739	
Russia, European	9,907,257	14,800,295	866,788	32,770,130	1,099,072	....	.04
Belgium	17,161,646	30,000	15,198,903	70,099,670	479,655	....	
Hawaii	a483,568,353	462,423,600	504,713,105	(b)	(b)	(b)	
Porto Rico	a89,883,098	107,208,014	72,558,181	(b)	(b)	(b)	
Other countries	30,889,693	93,759,153	51,062,420	7,687,309	208,452	1,731,132	
Total	3,844,273,384	3,980,250,569	4,018,086,530	3,975,005,840	3,031,915,875	4,216,108,106	100.00

a Annual average, 1899–1900. b No longer in the returns of foreign trade.

Quantity and value of sugar imported into the United States from the principal sources of supply during each fiscal year, from 1899 to 1903, inclusive—Continued.

VALUE.

Countries from which imported.	Annual average, 1899-1903.	Year ended June 30— 1899.	1900.	1901.	1902.	1903.	Per cent in 1903.
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	
Cuba	24,389,782	16,412,088	18,243,644	26,373,690	18,205,411	42,714,079	59.25
Dutch East Indies	17,306,114	19,817,616	24,170,081	16,965,511	12,325,518	13,251,816	18.38
British Guiana	3,749,980	3,461,889	3,779,398	4,803,479	3,372,104	3,333,032	4.62
British West Indies	4,414,840	6,049,479	4,603,409	5,058,565	3,226,575	3,136,172	4.35
Santo Domingo	2,630,598	2,659,456	3,365,061	2,959,067	2,061,977	2,107,428	2.92
Peru	1,699,241	921,430	1,444,784	2,702,180	1,910,311	1,517,514	2.11
Germany	9,393,300	14,095,417	12,346,731	15,556,811	3,597,234	1,370,305	1.90
Brazil	2,787,230	810,276	1,693,588	5,347,503	4,908,735	1,176,049	1.63
Egypt	1,886,597	3,570,343	1,843,077	1,653,695	1,351,038	1,014,831	1.41
Danish West Indies	529,082	556,562	544,985	460,694	377,581	705,587	.98
Austria-Hungary	2,062,261	1,485,037	2,132,790	3,727,094	2,288,547	677,836	.94
Dutch Guiana	472,407	953,047	375,633	382,876	349,242	301,235	.42
Philippine Islands	491,481	969,323	925,335	103,857	188,159	270,729	.38
Canada	144,461	139,023	94,809	108,137	123,441	256,894	.36
Mexico	48,584	52,995	41,082	35,994	9,408	103,439	.14
Guatemala	73,138	118,262	70,416	41,286	90,402	45,322	.06
Nicaragua	32,765	11,404	18,663	65,483	28,602	39,673	.06
Salvador	38,901	63,459	1,521	28,200	87,683	13,642	.02
Chinese Empire	145,885	296,574	125,986	229,795	63,429	13,640	.02
Netherlands	227,287	176,013	4,151	718,422	232,963	4,888	
Hongkong	61,738	141,767	69,697	70,753	24,202	2,270	
United Kingdom	257,966	434,237	228,447	431,959	192,945	2,241	
Russia, European	244,480	340,815	22,993	829,401	29,193	....	
Belgium	418,164	788	353,699	1,724,724	11,607	....	.05
Hawaii	a18,842,437	17,292,723	20,392,150	(b)	(b)	(b)	
Porto Rico	a2,472,733	2,495,849	2,449,616	(b)	(b)	(b)	
Other countries	538,242	1,638,218	909,225	108,624	4,790	30,351	
Total	82,570,593	94,964,120	100,250,974	90,487,800	55,061,097	72,088,973	100.00

a Annual average, 1899-1900. b No longer in the returns of foreign trade.

Production of beet and cane sugar in the United States.[a]

Years.	Beet.	Cane (Louisiana).	Total.[b]	Years.	Beet.	Cane (Louisiana).	Total.[b]
	Tons.[c]	*Tons.*[c]	*Tons.*[c]		*Tons.*[c]	*Tons.*[c]	*Tons.*[c]
1883-84	535	128,443	128,978	1894-95	20,092	317,334	337,426
1884-85	953	94,376	95,329	1895-96	29,220	237,721	266,941
1885-86	600	127,958	128,558	1896-97	37,536	282,009	319,545
1886-87	800	80,859	81,659	1897-98	40,398	310,313	350,711
1887-88	255	157,971	158,226	1898-99	32,471	248,658	281,129
1888-89	1,861	144,878	146,739	1899-1900	72,972	142,485	215,457
1889-90	2,203	130,413	132,616	1900-1901	76,859	270,338	317,197
1890-91	3,459	215,844	219,303	1901-2	163,126	310,000	473,126
1891-92	5,356	160,937	166,293	1902-3	195,463	300,000	495,463
1892-93	12,018	217,525	229,543	1903-4	208,135	215,000	423,135
1893-94	19,950	265,836	285,786				

a Data as to beet sugar are obtained from the following sources: For 1899-1900, from the Eleventh Census; for 1897-98, from a special report of the Department of Agriculture; and for other years from Willett and Gray. Data as to cane sugar are from the following sources: For 1889-90, 1898-99, and 1899-1900, from the Eleventh and Twelfth censuses; for 1901-2 and later years, from Willett and Gray; for other years, from Bouchereau's Annual Louisiana Sugar Reports (the figures for 1892-93 being taken from his revised statement).

b These figures do not include cane sugar produced outside of Louisiana; in 1889-90 such sugar amounted to 4,089 tons and 1899-1900 to 1,510 tons.

c Tons of 2,240 pounds.

RICE.

Wholesale prices of rice per pound, 1899–1903.

Date.	New York. Domestic (good).		Cincinnati. Prime.		Memphis. Not classed by name.		New Orleans.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	5½	5½	5¾	6½	4½	7	4¼	5
February	5	5¼	5¾	6½	4½	7	4¼	4¾
March	5¼	5¼	5¾	6¾	4¾	6½	4¼	4¾
April	5¼	5¼	5¾	6¾	3¾	6½	4¼	4¾
May	5¼	5¼	5½	6¾	3¾	6½	4¼	4¾
June	5¼	5¼	5½	6¼	4½	7	4¼	4¾
July	5¼	5¼	5½	6	4½	7	4¼	4¾
August	5	5¼	5½	6	4½	7	4¼	5
September	5	5	5½	6	4½	7	3¾	5¾
October	5	5⅛	5½	6	3½	7	3¾	6⅛
November	4¾	5	5¼	6	3	7	3¾	6⅜
December	4¾	4¾	5½	6	2½	7	3¾	6⅜
1900.								
January	4¾	4¾	5½	6	3	7	3¾	6⅜
February	4¾	4¾	5½	6	3	7	3¾	6⅜
March	4¾	4⅝	5½	6	3½	7	3¾	6⅜
April	4⅝	4⅝	5½	6	3¾	6½	3¾	6¼
May	4⅝	4⅝	5½	6	3	7	3¾	6½
June	4¾	4¾	5½	6	3	7½	4½	6⅝
July	4¾	4¾	5½	6	3	7½	4½	6⅝
August	4¾	4¾	5½	6	3	7½	4¼	6⅝
September	4¾	4⅞	5½	6	3½	7½	4¼	6¼
October	4¾	4⅞	5½	6	4	7½	4¼	6
November	4¾	5	5½	6	4	7	4¼	6
December	5	5	5½	6	3½	7½	4¼	6
1901.								
January	5	5	5½	6	......	......	......	......
February	4⅞	5	5½	6½	......	......	......	......
March	4⅞	4⅞	5½	6½	......	......	......	......
April	4⅞	4⅞	5½	6½	......	......	......	......
May	4⅞	4⅞	5½	6½	......	......	......	......
June	4⅞	4⅞	5½	6½	......	......	......	......
July	4¾	5	5½	6½	......	......	......	......
August	5	5	5½	6½	......	......	......	......
September	5	5	5½	6½	......	......	......	......
October	5	5	5½	6½	......	......	......	......
November	4⅞	4⅞	5½	6½	......	......	......	......
December	4¾	4¾	5½	6½	......	......	......	......
1602.								
January	4¾	4¾	5½	6½	......	......	......	......
February	4¾	4¾	5½	6½	......	......	......	......
March	4¾	4¾	5½	6½	......	......	......	......
April	4¾	4¾	5½	6½	......	......	......	......
May	4¾	5	5½	6½	......	......	......	......
June	4⅞	5¼	5½	6½	......	......	......	......
July	4⅞	5¼	5½	6½	......	......	......	......
August	4⅞	4⅞	5½	6½	......	......	......	......
September	4⅞	4⅞	5½	6½	......	......	......	......
October	4⅞	4⅞	5¼	5¾	......	......	......	......
November	4⅞	4⅞	5¼	5¾	......	......	......	......
December	5	5	5¼	5¾	......	......	......	......
1903.								
January	4⅞	5	4⅜	5¼	......	......	......	......
February	5	5	4⅜	5¼	......	......	......	......
March	5⅛	5¼	4⅜	5¼	......	......	......	......
April	5¼	5¼	4⅜	5¼	......	......	......	......
May	5¼	5¼	4⅜	5¼	......	......	......	......
June	5¼	5¼	4⅜	5¼	......	......	......	......
July	5¼	5¼	4⅜	5¼	......	......	......	......
August	5⅛	5¼	4⅜	5¼	......	......	......	......
September	4⅞	5⅛	4⅜	5¼	......	......	......	......
October	4½	4⅞	4⅜	5½	......	......	......	......
November	4¼	4½	4⅝	5½	......	......	......	......
December	4¼	4¼	4⅝	5½	......	......	......	......

BEANS.

Wholesale prices of beans per bushel in leading cities of the United States, 1899–1903.

Date.	New York.		Cincinnati.		Chicago.		Detroit.		San Francisco.	
	Pea.		Pea.		Pea.		Pea.		Small white, per cwt.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.										
January	$1.07	$1.27	$1.10	$1.20	$1.03	$1.16	$1.06	$1.13	$2.10	$2.25
February	1.10	1.26 13/16	1.05	1.20	1.13	1.25	1.06	1.20	2.15	2.25
March	1.10	1.35	1.05	1.45	1.16	1.25	1.15	1.20	2.15	2.25
April	1.10	1.33 5/8	1.35	1.45	1.15	1.25	1.14	1.17	2.20	2.30
May	1.10	1.32 11/16	1.35	1.45	.90	1.22	1.01	1.17	2.15	2.20
June	1.10	1.29 1/8	1.35	1.45	.90	1.13	1.01	1.06	2.00	2.10
July	1.14 5/8	1.38¼	1.15	1.25	.98	1.18	1.04	1.11	2.15	2.20
August	1.24¼	1.36	1.15	1.25	1.00	1.18	1.05	1.11	2.15	2.25
September	1.32 3/8	1.40	1.25	1.35	1.00	1.20	1.18	1.32	2.15	2.25
October	1.62	1.68¼	1.30	1.75	1.05	1.65	1.32	1.68	2.15	2.50
November	1.75	1.89	1.65	1.70	1.25	1.85	1.68	1.80	2.90	3.00
December	1.77 5/8	2.00	1.65	1.70	1.60	1.87	1.78	1.80	2.90	3.00
1900.										
January	1.86½	2.06¼	2.25	2.40	1.70	2.12½	1.78	2.05	2.85	3.00
February	1.98	2.13	2.40	2.40	1.90	2.10	1.98	2.05	3.15	3.25
March	1.90	2.11	2.20	2.40	1.90	2.10	2.00	2.00	3.15	3.35
April	1.90	2.15	2.10	2.15	1.90	2.20	2.00	2.08	3.40	3.50
May	1.85 3/8	2.25	2.00	2.55	1.90	2.18	2.08	2.10	3.40	3.50
June	1.80	2.25	2.45	2.55	1.90	2.16	2.10	2.10	3.25	3.40
July	1.80	2.21¼	2.45	2.55	1.90	2.15	2.10	2.10	3.40	3.50
August	1.75¼	2.08	2.45	2.55	1.90	2.15	Not quoted.		3.50	3.65
September	1.79	2.07 1/8	2.10	2.55	1.75	2.25	1.55	1.70	3.75	4.00
October	1.95	2.10	2.10	2.25	1.65	1.90	1.70	1.84	3.60	3.75
November	1.91	2.05	2.10	2.25	1.68	1.87	1.70	1.90	3.90	4.00
December	2.14	2.17	2.10	2.25	1.70	2.10	1.90	2.08	4.00	4.50
1901.										
January	2.25	2.35	2.50	2.55	1.75	2.20	1.85	2.15	3.60	4.70
February	2.20	2.27½	2.50	2.50	1.80	2.10	1.94	2.00	3.75	4.90
March	2.00	2.25	2.40	2.50	.90	2.02	1.80	1.88	3.60	4.90
April	2.00	2.12½	2.40	2.40	1.25	1.97	1.80	1.90	3.75	4.95
May	1.97½	2.10	2.40	2.40	1.25	1.90	1.74	1.80	3.70	4.95
June	1.95	2.12½	2.40	2.40	1.50	2.05	1.75	1.95	3.60	4.90
July	2.07½	2.25	2.40	2.40	1.60	2.50	1.85	2.40	3.40	5.00
August	2.30	2.77½	2.40	3.00	2.10	2.80	2.40	2.40	2.00	4.25
September	2.25	2.75	3.00	3.00	1.65	2.80	2.40	2.40	2.05	4.25
October	2.05	2.30	2.60	3.00	1.55	2.00	1.68	1.92	2.00	5.00
November	1.95	2.05	2.60	2.75	1.50	1.92	1.66	1.85	2.50	3.50
December	1.95	2.00	2.60	2.75	1.69	1.87	1.72	1.81	2.80	3.25
1902.									Lima.	
January	1.75	2.00	2.60	2.70	1.40	1.83	1.60	1.79	4.40	4.65
February	1.65	1.80	2.60	2.70	1.40	1.75	1.53	1.62	4.40	4.60
March	1.60	1.75	2.60	2.70	1.20	1.65	1.28	1.51	4.35	4.40
April	1.50	1.82½	2.30	2.70	.85	1.80	1.28	1.62	3.30	3.60
May	1.75	1.85	2.30	2.60	1.50	1.85	1.56	1.75	3.60	3.80
June	1.60	1.70	2.30	2.60	1.50	1.70	1.48	1.60	3.60	3.85
July	1.65	2.00	2.30	2.50	1.60	1.90	1.60	1.90	3.60	3.85
August	1.95	2.05	2.30	2.50	1.60	1.96	1.63	1.90	3.80	4.10
September	1.90	1.95	2.30	2.50	1.60	1.90	1.75	1.85	3.70	3.90
October	1.92½	2.45	2.25	2.50	1.78	2.49	1.70	1.98	4.10	4.35
November	2.30	2.45	2.20	2.40	2.15	2.30	1.66	1.88	4.20	4.50
December	2.25	2.37½	2.25	2.40	2.15	2.30	1.74	1.81	4.25	4.55
1903.			Navy.							
January	2.35	2.37½	2.40	2.50	1.25	2.40	2.24	2.35	....	....
February	2.32½	2.40	2.25	2.50	1.20	2.30	2.10	2.23	....	....
March	2.20	2.30	2.30	2.40	1.25	2.25	2.10	2.16	....	....
April	2.00	2.25	2.15	2.40	.90	2.20	1.88	2.10	....	....
May	2.15	2.35	2.15	2.25	.90	2.30	2.07	2.35	....	....
June	2.30	2.35	2.15	2.25	1.25	2.35	2.20	2.25	....	....
July	2.27½	2.32½	2.15	2.25	1.20	2.23	2.10	2.21	....	....
August	2.15	2.27½	2.15	2.25	1.15	2.25	1.91	1.96	....	....
September	2.25	2.40	2.15	2.25	1.50	2.50	2.10	2.35	....	....
October	2.15	2.40	2.15	2.25	1.05	2.25	1.90	2.28	....	....
November	2.10	2.25	2.15	2.25	1.05	2.15	1.90	2.00	....	....
December	2.05	2.15	2.05	2.25	1.35	2.00	1.82	1.90	....	....

CLOVER SEED.

Wholesale prices of clover seed per 100 pounds (60 pounds to the bushel), 1899–1903.

Date.	Cincinnati.		Chicago.		Toledo.		Detroit.	
	Prime (per bushel)		Poor to choice.		Poor to choice (per bushel).		Per bushel.	
	Low.	High.	Low.	High.	Low	High.	Low.	High.
1899.								
January	$3.00	$3.75	$3.00	$7.00	$4.00	$4.72½	$3.80	$4.65
February	3.00	3.50	3.00	6.50	3.90	4.07½	3.85	4 15
March	2.85	3.40	3.00	6.10	3.42½	3.85	3.40	3.80
April	2.85	3.10	2 50	6.25	3.50	3.80	3.45	3.75
May	2.75	3.10	3.00	6.40	3.50	3.85	3.50	4.00
June	2.75	3.00	3.00	6.65	3.77½	4.05	3.80	4.00
July	2.75	3.25	1.50	6.65	3.85	4.00	3.90	4.00
August	3.00	3.50	2.50	6.50	3.75	4.05	3.75	4.00
September	3.50	3.75	2.50	7.75	4.60	5.85	4.75	6.25
October	3.75	4.50	5.75	8.60	5.50	6.80	5.90	6.50
November	3.85	4.50	5.00	8.00	5.40	6.20	5.35	5.75
December	3.85	4.50	3.00	8.50	5.40	5.72	5.40	5.70
1900.								
January	4.00	4.50	5.00	8.40	5.57½	5.80	5.60	5.75
February	4.00	4.50	5.00	8.50	5.55	5.80	5.50	5.75
March	4.00	4.65	5.00	8.50	5.20	5.67½	5.20	5.50
April	4.00	4.65	4.00	8.10	4.95	5.15	4.80	5.05
May	4.00	4.20	4.00	7.50	5.00	5.00	4.80	4.90
June	4.00	4.50	4.50	8.00	5.10	5.30	4.90	5.35
July	4.25	4.50	4.50	8.00	5.50	5.50	5.10	5.35
August	4.25	5 20	4.00	10.25	5.40	6.20	5.75	6.55
September	4.80	5.75	5.00	10.25	6.10	6.10	6.55	6.90
October	5.00	6.00	5.00	10.75	6.50	7.85	6.65	7.10
November	5.00	5.70	5.00	10.25	6.15	6.40	6.75	6.90
December	5.00	5.70	4.00	10.50	6.60	6.87½	6.70	6.80
1901.					Prime.			
January	5.50	6.25	4.00	11.00	7.10	7.35	6.90	7.30
February	5.75	6.60	5.00	11.50	6.80	7.40	6.75	7.35
March	6.00	6.40	5.00	11.15	6.55	6.75	6.50	6.80
April	5.80	6.40	5.00	11.00	6.50	6.75	6.50	6.65
May	5.80	6.00	4.00	10.75	6.30	6.57½	6.00	6.50
June	......	......	5.00	9.50	6.40	6.50	6.00	6.00
July	......	......	6.00	10.00	6.20	6.60	6.00	6.25
August	6.00	6.00	7.00	10.25	5.80	6.60	5.85	6.50
September	4.85	5.80	4.50	10.40	5.15	5.90	5.15	5.90
October	4.50	5.10	4.50	8.75	5.15	5.60	5.15	5.60
November	4.60	5.25	5.00	9.25	5.40	5.65	5.40	5.65
December	4.75	5.60	6.00	9.50	5.62½	5.90	5.65	5.90
1902.	Per 100 lbs.							
January	8.65	9.60	7.00	10.00	4.25	6.15	5.70	6.10
February	8.65	9.20	6.50	9.70	4.95	5.80	5.55	5.80
March	8.00	9.20	6.00	9.00	4.30	5.65	5.10	5.55
April	7.10	8.35	4.00	8.35	3.90	5.30	4.90	5.20
May	6.85	7.50	5.50	8.35	3.90	5.22½	5.00	5.20
June	6.85	7.30	6.00	8.35	4.00	5.25	Not quoted.	
July	6.85	7.50	6.00	8.40	4.10	5.30	Not quoted.	
August	7.10	8.35	6.00	9.10	4.20	5.60	Not quoted.	
September	7.10	8.35	7.00	9.50	4.25	5.65	5.15	5.90
October	7.50	8.75	7.00	11.35	4.70	7.00	5.15	5.60
November	7.50	9.20	8.00	11.15	4.75	7.10	5.35	5.65
December	8.35	9.20	8.00	10.90	5.50	6.85	5.60	5.90
1903.	Per bushel.							
January	5.25	6.50	8.50	11.90	4.40	7.42½	7.25	7.30
February	6.00	6.50	9.25	11.90	5.25	7.25	7.00	7.10
March	6.25	7.10	......	12.50	4.00	7.42½	6.95	7.40
April	6.00	6.90	5.00	12.25	3.60	7.62½	6.60	7.25
May	5.40	7.00	8.00	12.50	4.00	7.70	7.50	7.50
June	5.40	6.00	8.00	11.75	6.00	6.75	Not quoted.	
July	......	......	8.00	12.50	6.40	7.10	Not quoted.	
August	......	......	8.50	12.50	4.85	7.10	Not quoted.	
September	5.00	5.70	5.00	11.00	4.00	6.65	Not quoted.	
October	5.25	5.70	6.00	11.50	3.75	6.80	6.45	6.90
November	5.25	5.60	4.00	11.00	3.40	6.82½	6.50	6.60
December	5.25	6.00	6.00	11.25	3.05	7.05	6.80	6.95

TIMOTHY SEED.

Wholesale prices of timothy seed per 100 pounds (45 pounds to the bushel), 1899–1903.

Date.	Cincinnati.		Chicago.		Milwaukee.	
	Per bushel.		Per 100 lbs.		Per 100 lbs.	
	Low.	High.	Low.	High.	Low.	High.
1899.						
January	$0.95	$1.05	$2.30	$2.42½	$1.70	$2.50
February	1.00	1.05	2.40	2.50	1.85	2.50
March	1.00	1.05	2.25	2.40	1.75	2.50
April	1.00	1.05	2.25	2.47½	1.75	2.75
May	1.00	1.05	2.25	2.40	1.90	2.65
June	......	......	2.30	2.40	1.90	2.65
July	......	......	2.40	2.50	1.90	2.80
August	1.10	1.15	2.40	2.55	1.75	2.80
September	1.10	1.15	2.35	2.50	1.80	2.60
October	1.03	1.15	2.35	2.50	1.80	2.45
November	1.03	1.07	2.37½	2.50	1.90	2.45
December	1.03	1.07	2.40	2.45	1.85	2.50
1900.						
January	1.03	1.07	2.47½	2.55	2.00	2.50
February	1.03	1.12	2.40	2.55	2.00	2.50
March	1.05	1.12	2.32½	2.50	1.90	2.55
April	1.07	1.12	2.35	2.47½	1.90	2.55
May	1.07	1.12	2.40	2.55	1.90	2.60
June	1.07	1.12	2.40	3.40	2.00	3.15
July	1.15	1.40	3.00	3.40	2.65	3.25
August	1.35	1.80	3.00	4.02½	2.75	4.25
September	1.60	1.95	3.90	4.60	3.50	4.50
October	1.70	2.00	4.15	4.40	3.50	4.30
November	1.70	1.85	4.20	4.55	3.50	4.20
December	1.70	1.85	4.45	4.65	3.50	4.40
1901.						
January	1.70	2.00	4.60	4.77½	3.65	4.50
February	1.85	2.05	4.35	4.60	4.00	4.50
March	1.85	2.00	4.00	4.40	3.75	4.40
April	1.80	1.95	3.75	4.15	3.50	4.20
May	1.80	1.85	3.35	3.90	3.00	4.00
June	......	......	3.60	4.30	3.00	4.60
July	......	......	4.30	5.25	3.65	5.25
August	2.00	2.40	4.90	5.75	3.75	5.25
September	2.30	2.40	5.20	5.70	4.25	5.25
October	2.35	2.60	5.50	5.90	4.25	5.60
November	2.50	2.65	5.75	6.35	4.50	6.00
December	2.50	2.90	6.35	6.55	5.00	6.50
1902.	Per 100 lbs.					
January	6.10	6.40	5.00	6.55	5.50	6.25
February	6.10	6.40	5.00	6.60	5.50	6.25
March	6.10	6.40	5.00	7.00	5.50	6.60
April	6.40	6.60	4.50	7.10	6.00	6.75
May	......	......	5.00	7.35	5.50	6.75
June	......	......	4.50	6.35	5.00	6.25
July	......	......	4.50	5.75	4.00	5.75
August	3.90	4.40	3.25	5.75	3.75	5.00
September	3.80	4.00	2.00	4.75	2.75	4.10
October	3.30	3.65	2.00	4.20	2.50	3.75
November	3.40	3.65	2.00	4.25	3.00	3.75
December	3.40	3.65	2.00	4.25	3.00	3.75
1903.	Per bushel.					
January	1.55	1.70	2.50	4.35	3.00	3.75
February	1.55	1.70	2.50	4.35	3.00	3.75
March	1.45	1.65	2.00	3.95	2.00	3.75
April	1.35	1.50	2.00	3.70	2.00	3.25
May	1.35	1.50	2.00	3.75	2.25	2.90
June	1.35	1.60	2.00	4.00	2.35	3.35
July	......	......	1.75	3.65	2.60	3.35
August	......	......	1.75	3.40	2.50	3.25
September	1.35	1.50	2.50	3.40	2.50	3.25
October	1.25	1.50	2.00	3.17½	2.30	3.00
November	1.25	1.40	2.00	3.00	2.25	2.85
December	1.20	1.40	2.00	3.05	2.25	2.75

Monthly average prices per bushel of timothy seed in Chicago.[a]

Month.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	$2.79	$4.42½	$4.25	$5.71¼	$3.68¾	$2.70	$2.73¾	$2.36¼	$2.51¼	$4.68¾	$6.40	$4.30
February	2.86	4.46¼	4.17½	5.75	3.75	2.65	2.86¼	2.45	2.47½	4.47½	6.50	4.05
March	2.88	4.34	4.20	5.56¼	3.35	2.67½	2.90	2.32½	2.41¼	4.20	6.70	3.65
April	2.91½	4.13	4.27½	5.32½	3.25	2.85	2.81¼	2.36¼	2.41¼	3.95	7.02½	3.35
May	2.91½	3.87½	4.07½	5.25	3.25	2.90	2.80	2.32½	2.47½	3.62½	6.82½	3.60
June	2.97	3.75	4.37½	5.37½	3.05	2.73¾	2.70	2.35	2.90	3.95	6.05	3.80
July	2.94½	3.97½	4.92½	5.80	3.02½	2.72½	2.57½	2.45	3.20	4.77½	5.60	3.50
August	4.26	3.52½	5.32½	4.80	2.87½	2.81¼	2.47½	2.47½	3.51¼	5.32½	4.80	3.27½
September	3.78	3.35	5.50	3.95	2.56¼	2.75	2.41¼	2.42½	4.25	5.45	4.10	3.25
October	4.05½	3.32½	5.43¾	3.50	2.55	2.66¼	2.27½	2.42½	4.27½	5.70	3.95	2.96¼
November	4.14½	3.27½	5.52½	3.57½	2.56¼	2.66¼	2.22½	2.43¾	4.37½	6.05	3.92½	2.92½
December	4.40	3.85	5.60	3.52½	2.62½	2.68¾	2.25	2.42½	4.55	6.45	4.12½	2.95
Yearly average	3.41	3.85⅔	4.80½	4.84⅜	3.04½	2.73 7/16	2.58 9/16	2.40⅛	3.27 11/12	4.88⅔	5.50	3.46¾

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

FARM ANIMALS AND THEIR PRODUCTS.

HORSES AND MULES.

Number and farm value of horses and mules, 1880-1904.

January 1—	Horses.		Mules.	
	Number.	Value.	Number.	Value.
1880	11,201,800	$613,296,611	1,729,500	$105,948,319
1881	11,429,626	667,954,325	1,720,731	120,096,164
1882	10,521,554	615,824,914	1,835,169	130,945,378
1883	10,838,111	765,041,308	1,871,079	148,732,390
1884	11,169,683	833,734,400	1,914,126	161,214,976
1885	11,564,572	852,282,947	1,972,569	162,497,097
1886	12,077,657	860,823,208	2,052,593	163,381,096
1887	12,496,744	901,685,755	2,117,141	167,057,538
1888	13,172,936	946,096,154	2,191,727	174,853,563
1889	13,663,294	982,194,827	2,257,574	179,444,481
1890	14,213,837	978,516,562	2,331,027	182,394,099
1891	14,056,750	941,823,222	2,296,532	178,847,370
1892	15,498,140	1,007,593,636	2,314,699	174,882,070
1893	16,206,802	992,225,185	2,331,128	164,763,751
1894	16,081,139	769,224,799	2,352,231	146,232,811
1895	15,893,318	576,730,580	2,333,108	110,927,834
1896	15,124,057	500,140,186	2,278,946	103,204,457
1897	14,364,667	452,649,396	2,215,654	92,302,090
1898	13,960,911	478,362,407	2,190,282	96,109,516
1899	13,665,307	511,074,813	2,134,213	95,963,261
1900	13,537,524	603,969,442	2,086,027	111,717,092
1901	16,744,723	885,200,168	2,864,458	183,232,209
1902	16,531,224	968,935,178	2,757,017	186,411,704
1903	16,557,373	1,030,705,959	2,728,088	197,753,327
1904	16,736,059	1,136,940,298	2,757,916	217,532,832

Imports and exports of horses and mules, with average prices, 1892-1903.

Year ended June 30—	Imports of horses.			Exports of horses.			Exports of mules.		
	Number.	Value.	Average price.	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	14,074	$2,455,868	$174.50	3,226	$611,188	$189.46	1,965	$238,591	$121.42
1893	15,451	2,388,267	154.57	2,967	718,607	242.20	1,634	210,278	128.69
1894	6,166	1,319,572	214.01	5,246	1,108,995	211.40	2,063	240,961	116.80
1895	13,098	1,055,191	80.56	13,984	2,209,298	157.99	2,515	186,452	74.14
1896	9,991	662,591	66.32	25,126	3,530,703	140.52	5,918	406,161	68.63
1897	6,998	464,808	66.42	39,532	4,769,265	120.64	7,473	545,331	72.97
1898	3,085	414,899	134.49	51,150	6,176,569	120.75	8,098	664,789	82.09
1899	3,042	551,050	181.15	45,778	5,444,342	118.93	6,755	516,908	76.52
1900	3,102	596,592	192.32	64,722	7,612,616	117.62	43,369	3,919,478	90.38
1901	3,785	985,738	260.43	82,250	8,873,845	107.89	31,405	3,210,267	93.31
1902	4,832	1,577,234	326.41	103,020	10,048,046	97.53	27,586	2,692,298	97.60
1903	4,998	1,533,796	306.88	34,007	3,152,159	92.69	4,295	521,725	121.47

Number, average price, and farm value of horses and mules in the United States January 1, 1904, by States.

States and Territories.	Horses.			Mules.		
	Number.	Average farm price, Jan. 1.	Farm value.	Number.	Average farm price, Jan. 1.	Farm value.
Maine	123,773	$85.43	$10,573,812			
New Hampshire	64,268	79.96	5,138,899			
Vermont	88,247	81.42	7,184,807			
Massachusetts	140,332	88.04	12,354,201			
Rhode Island	15,923	95.00	1,512,649			
Connecticut	57,428	83.91	4,819,022			
New York	631,287	93.76	59,186,681	3,825	$92.39	$353,382
New Jersey	95,230	99.28	9,454,882	5,024	98.21	493,413
Pennsylvania	595,594	89.64	53,391,436	37,776	93.36	3,526,759
Delaware	34,742	80.06	2,781,538	5,334	95.68	510,380
Maryland	142,260	76.61	10,897,856	17,901	97.62	1,747,410
Virginia	259,907	68.97	17,926,388	41,599	86.16	3,583,996
North Carolina	160,814	81.06	13,035,058	139,428	95.65	13,336,658
South Carolina	73,991	84.64	6,262,562	105,537	99.59	10,510,088
Georgia	121,922	94.94	11,575,478	195,204	104.02	20,305,732
Florida	45,589	68.97	3,144,392	15,118	97.08	1,467,672
Alabama	146,291	62.79	9,185,063	156,892	85.50	13,414,873
Mississippi	247,280	64.71	16,002,539	211,444	84.08	17,777,623
Louisiana	181,255	57.24	10,375,510	134,876	88.17	11,891,393
Texas	1,252,714	35.16	44,047,429	399,018	55.09	21,983,352
Arkansas	243,672	54.27	13,225,095	160,106	74.82	11,979,477
Tennessee	277,884	69.97	19,444,012	170,824	81.86	13,984,310
West Virginia	170,737	70.14	11,975,475	9,988	71.08	709,992
Kentucky	359,411	69.34	24,921,020	141,624	79.26	11,225,763
Ohio	801,932	83.96	67,335,165	16,291	80.84	1,316,983
Michigan	548,015	88.57	48,538,005	2,686	62.61	168,159
Indiana	642,567	80.12	51,482,058	56,309	82.24	4,630,902
Illinois	1,120,276	80.60	90,297,838	110,930	78.38	8,694,882
Wisconsin	545,725	85.50	46,658,534	4,796	77.47	371,534
Minnesota	675,202	74.56	50,343,952	8,164	72.21	589,537
Iowa	1,156,016	72.41	83,712,676	44,996	72.00	3,239,722
Missouri	801,868	67.46	54,093,772	202,888	77.44	15,710,951
Kansas	871,908	63.34	55,226,565	90,773	71.41	6,481,783
Nebraska	779,953	60.00	46,795,623	47,182	70.99	3,349,436
South Dakota	458,096	56.66	25,955,764	6,893	61.79	425,940
North Dakota	369,533	67.93	25,101,324	7,102	79.12	561,919
Montana	244,104	36.82	8,988,890	3,390	47.66	161,552
Wyoming	104,368	25.73	2,685,679	1,466	59.51	87,243
Colorado	203,283	41.92	8,521,713	9,098	57.61	524,099
New Mexico	115,932	17.52	2,031,649	5,047	34.81	175,673
Arizona	108,781	26.83	2,918,733	3,701	47.76	176,751
Utah	105,309	42.98	4,525,673	2,044	36.44	74,485
Nevada	79,812	46.03	3,674,072	2,217	49.75	110,303
Idaho	142,348	37.61	5,353,451	1,551	49.41	76,635
Washington	221,328	66.72	14,766,354	2,319	60.67	140,704
Oregon	212,888	51.30	10,921,551	6,944	51.67	358,824
California	367,009	65.66	24,099,139	67,031	72.68	4,871,487
Oklahoma	344,637	49.93	17,207,124	61,185	63.50	3,885,388
Indian Territory	184,618	39.48	7,289,190	41,395	61.50	2,545,667
United States	16,736,059	67.93	1,136,940,298	2,757,916	78.88	217,532,832

Range of prices for horses in Omaha, monthly, 1899–1903.

Date.	Drafts.		General purposes.		Southern.		Western.		Drivers.		Carriage teams.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.												
January	$75.00	$115.00	$35.00	$60.00	$20.00	$45.00	$10.00	$20.00	$95.00	$225.00	$200.00	$300.00
February	80.00	120.00	35.00	65.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
March	90.00	125.00	40.00	65.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
April	90.00	140.00	40.00	70.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
May	100.00	150.00	40.00	70.00	20.00	45.00	12.50	22.50	90.00	325.00	300.00	450.00
June	90.00	140.00	40.00	65.00	15.00	45.00	12.50	25.00	90.00	325.00	300.00	450.00
July	90.00	140.00	40.00	60.00	15.00	45.00	15.00	27.50	75.00	200.00	200.00	325.00
August	90.00	140.00	40.00	60.00	15.00	45.00	17.50	30.00	75.00	220.00	210.00	420.00
September	90.00	140.00	40.00	60.00	15.00	45.00	20.00	40.00	85.00	175.00	215.00	360.00
October	100.00	160.00	40.00	65.00	20.00	45.00	30.00	77.50	90.00	215.00	175.00	435.00
November	90.00	150.00	40.00	60.00	20.00	50.00	30.00	65.00	90.00	325.00	230.00	370.00
December	100.00	160.00	35.00	60.00	20.00	55.00	29.00	45.00	90.00	300.00	200.00	375.00
1900.												
January	75.00	135.00	55.00	85.00	20.00	45.00	10.00	20.00	95.00	225.00	200.00	300.00
February	80.00	150.00	55.00	90.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
March	90.00	165.00	55.00	90.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
April	90.00	175.00	60.00	100.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
May	100.00	150.00	65.00	105.00	20.00	45.00	12.50	22.50	90.00	325.00	300.00	450.00
June	90.00	140.00	40.00	65.00	15.00	45.00	12.50	25.00	90.00	325.00	300.00	450.00
July	90.00	140.00	40.00	60.00	15.00	45.00	15.00	27.50	75.00	200.00	200.00	325.00
August	90.00	140.00	40.00	60.00	15.00	45.00	17.50	30.00	75.00	220.00	210.00	420.00
September	90.00	140.00	40.00	60.00	15.00	45.00	20.00	40.00	85.00	175.00	215.00	360.00
October	100.00	160.00	40.00	65.00	20.00	45.00	30.00	77.50	90.00	215.00	175.00	435.00
November	90.00	150.00	40.00	60.00	20.00	50.00	12.50	45.00	90.00	325.00	230.00	370.00
December	100.00	160.00	35.00	60.00	20.00	55.00	12.50	40.00	90.00	300.00	200.00	375.00
1901.												
January	90.00	150.00	55.00	85.00	25.00	60.00	10.00	30.00	95.00	225.00	200.00	300.00
February	95.00	160.00	55.00	90.00	25.00	60.00	10.00	30.00	95.00	225.00	200.00	300.00
March	90.00	165.00	55.00	90.00	20.00	55.00	10.00	30.00	95.00	225.00	200.00	300.00
April	90.00	200.00	60.00	100.00	20.00	50.00	10.00	35.00	95.00	225.00	200.00	400.00
May	100.00	200.00	65.00	105.00	20.00	45.00	12.50	35.00	90.00	325.00	300.00	450.00
June	90.00	150.00	40.00	80.00	20.00	45.00	12.50	40.00	90.00	325.00	300.00	450.00
July	90.00	160.00	40.00	80.00	15.00	45.00	10.00	45.00	75.00	200.00	200.00	400.00
August	90.00	160.00	40.00	80.00	15.00	45.00	5.00	40.00	75.00	220.00	210.00	420.00
September	90.00	175.00	40.00	80.00	15.00	45.00	5.00	50.00	85.00	175.00	215.00	360.00
October	100.00	175.00	40.00	80.00	20.00	45.00	10.00	60.00	90.00	215.00	175.00	435.00
November	90.00	160.00	40.00	80.00	20.00	50.00	10.00	45.00	90.00	325.00	230.00	370.00
December	100.00	160.00	45.00	85.00	20.00	55.00	12.50	40.00	90.00	300.00	200.00	375.00
1902.												
January	90.00	175.00	55.00	85.00	35.00	80.00	10.00	50.00	95.00	225.00	200.00	350.00
February	95.00	185.00	60.00	100.00	35.00	80.00	10.00	50.00	95.00	225.00	200.00	350.00
March	100.00	200.00	60.00	100.00	35.00	80.00	10.00	50.00	95.00	225.00	200.00	350.00
April	100.00	225.00	60.00	110.00	30.00	65.00	10.00	50.00	100.00	250.00	200.00	500.00
May	100.00	250.00	65.00	105.00	25.00	60.00	12.50	60.00	90.00	325.00	300.00	500.00
June	90.00	200.00	60.00	90.00	20.00	45.00	12.50	60.00	90.00	325.00	300.00	450.00
July	90.00	175.00	40.00	80.00	15.00	45.00	10.00	65.00	75.00	200.00	200.00	400.00
August	90.00	175.00	40.00	80.00	15.00	45.00	10.00	80.00	75.00	220.00	210.00	420.00
September	90.00	175.00	40.00	80.00	15.00	45.00	10.00	100.00	85.00	175.00	215.00	360.00
October	100.00	175.00	40.00	80.00	20.00	45.00	10.00	100.00	90.00	215.00	175.00	435.00
November	90.00	160.00	40.00	80.00	20.00	65.00	10.00	80.00	90.00	325.00	230.00	370.00
December	100.00	185.00	45.00	85.00	20.00	70.00	12.50	60.00	90.00	300.00	200.00	375.00
1903.												
January	90.00	175.00	50.00	80.00	35.00	70.00	10.00	50.00	95.00	225.00	200.00	350.00
February	95.00	185.00	60.00	100.00	35.00	75.00	10.00	50.00	95.00	225.00	200.00	350.00
March	100.00	200.00	60.00	110.00	35.00	70.00	10.00	50.00	100.00	230.00	200.00	400.00
April	100.00	250.00	60.00	110.00	30.00	65.00	10.00	50.00	100.00	250.00	200.00	500.00
May	110.00	250.00	65.00	105.00	20.00	55.00	12.50	60.00	100.00	350.00	250.00	550.00
June	90.00	200.00	65.00	100.00	15.00	40.00	12.50	65.00	100.00	375.00	300.00	450.00
July	90.00	175.00	50.00	80.00	15.00	45.00	10.00	65.00	75.00	275.00	200.00	400.00
August	90.00	175.00	45.00	80.00	15.00	45.00	10.00	90.00	75.00	220.00	210.00	420.00
September	90.00	175.00	40.00	80.00	15.00	45.00	10.00	100.00	95.00	200.00	215.00	360.00
October	100.00	180.00	40.00	80.00	20.00	45.00	10.00	100.00	90.00	215.00	200.00	435.00
November	90.00	160.00	45.00	85.00	20.00	60.00	10.00	80.00	100.00	325.00	225.00	370.00
December	100.00	185.00	45.00	85.00	20.00	60.00	12.50	60.00	100.00	300.00	200.00	375.00

CATTLE AND DAIRY PRODUCTS.

Number and farm value of milch cows and other cattle, 1880 to 1904.

January 1—	Milch cows.		Other cattle.	
	Number.	Value.	Number.	Value.
1880	12,027,000	$279,899,420	21,231,000	$341,761,154
1881	12,368,653	296,277,060	20,938,710	362,861,509
1882	12,611,632	326,489,310	23,280,238	463,069,501
1883	13,125,685	396,575,405	28,046,077	611,549,109
1884	13,501,206	423,486,649	29,046,101	683,229,054
1885	13,904,722	412,903,093	29,866,573	694,382,913
1886	14,235,388	389,985,523	31,275,242	661,956,274
1887	14,522,083	378,789,589	33,511,750	663,137,926
1888	14,856,414	366,252,173	34,378,363	611,750,520
1889	15,298,625	366,226,376	35,032,417	597,236,812
1890	15,952,883	353,152,133	36,849,024	560,625,137
1891	16,019,591	346,397,900	36,875,648	544,127,908
1892	16,416,351	351,378,132	37,651,239	570,749,155
1893	16,424,087	357,299,785	35,954,196	547,882,204
1894	16,487,400	358,998,661	36,608,168	536,789,747
1895	16,504,629	362,601,729	34,364,216	482,999,129
1896	16,137,586	363,955,545	32,085,409	508,928,416
1897	15,941,727	369,239,993	30,508,408	507,929,421
1898	15,840,886	434,813,826	29,264,197	612,296,634
1899	15,990,115	474,233,925	27,994,225	637,931,135
1900	16,292,360	514,812,106	27,610,054	689,486,260
1901	16,833,657	505,093,077	45,500,213	906,644,003
1902	16,696,802	488,130,324	44,727,797	839,126,073
1903	17,105,227	516,711,914	44,659,206	824,054,902
1904	17,419,817	508,841,489	43,629,498	712,178,134

Imports and exports of live cattle with average prices, 1892 to 1903.

Year ended June 30—	Imports.			Exports.		
	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	2,168	$47,466	$21.89	394,607	$35,099,095	$88.95
1893	3,293	45,682	13.87	287,094	26,032,428	90.68
1894	1,592	18,704	11.75	359,278	33,461,922	93.14
1895	149,781	765,853	5.11	331,722	30,603,796	92.26
1896	217,826	1,509,856	6.93	372,461	34,560,672	92.79
1897	328,977	2,589,857	7.87	392,190	36,357,451	92.70
1898	291,589	2,913,223	9.99	439,255	37,827,500	86.12
1899	199,752	2,320,362	11.62	389,490	30,516,833	78.35
1900	181,006	2,257,694	12.47	397,286	30,635,153	77.11
1901	146,022	1,931,433	13.23	459,218	37,566,980	81.81
1902	96,027	1,608,722	16.75	392,884	29,902,212	76.11
1903	66,166	1,161,548	17.56	402,178	29,848,936	74.22

Number, average price, and farm value of cattle in the United States on January 1, 1904.

States and Territories.	Milch cows.			Other cattle.		
	Number.	Average farm price, Jan. 1.	Farm value.	Number.	Average farm price, Jan. 1.	Farm value.
Maine	185,417	$29.91	$5,545,822	122,440	$15.74	$1,926,613
New Hampshire	124,904	31.01	3,873,273	102,210	15.33	1,566,520
Vermont	288,197	26.32	7,585,345	223,634	13.73	3,070,176
Massachusetts	188,740	40.40	7,625,096	94,334	17.11	1,614,376
Rhode Island	25,723	40.10	1,031,492	10,519	19.25	203,026
Connecticut	129,567	39.50	5,117,896	86,609	20.37	1,764,493
New York	1,655,328	35.49	58,747,591	936,300	18.08	16,921,181
New Jersey	179,241	39.04	6,997,569	82,061	20.33	1,668,489
Pennsylvania	1,055,071	34.08	35,956,820	798,449	21.83	17,431,341
Delaware	34,779	33.91	1,179,356	21,390	17.61	376,622
Maryland	148,912	29.63	4,412,263	132,652	18.49	2,452,653
Virginia	255,280	24.76	6,320,733	436,189	17.04	7,431,780
North Carolina	197,431	22.36	4,414,557	298,539	10.74	3,206,759
South Carolina	110,812	24.48	2,712,678	176,603	11.17	1,972,444
Georgia	280,096	22.68	6,352,577	635,494	11.36	7,219,407
Florida	86,149	23.38	2,014,164	522,526	9.09	4,749,132
Alabama	232,444	19.57	4,548,929	379,353	7.70	2,922,797
Mississippi	269,311	22.38	6,027,180	423,132	9.60	4,060,881
Louisiana	168,000	24.39	4,097,520	401,945	10.29	4,168,908
Texas	821,991	19.66	16,160,343	8,087,989	10.13	81,928,093
Arkansas	278,082	18.39	5,113,928	468,964	7.65	3,587,246
Tennessee	285,383	22.23	6,344,064	433,557	11.43	4,954,470
West Virginia	182,201	28.66	5,221,881	345,209	20.64	7,123,727
Kentucky	295,584	25.05	7,404,379	488,561	16.64	8,131,271
Ohio	782,866	33.17	25,967,665	1,154,323	21.37	24,666,963
Michigan	550,643	32.79	18,055,584	729,077	16.71	12,180,406
Indiana	553,115	30.57	16,908,726	895,583	21.13	18,919,826
Illinois	1,005,484	33.81	33,995,414	1,683,709	24.78	41,714,062
Wisconsin	1,063,944	31.00	32,982,264	1,137,211	14.59	16,593,165
Minnesota	820,439	25.45	20,880,173	932,481	11.41	10,636,253
Iowa	1,363,094	29.09	39,652,404	3,502,532	22.10	77,395,457
Missouri	581,415	26.04	15,140,047	1,419,132	19.40	27,525,913
Kansas	699,246	24.91	17,418,218	2,604,174	18.90	49,228,000
Nebraska	649,839	26.53	17,240,229	2,355,919	17.48	41,184,298
South Dakota	386,253	24.93	9,629,287	1,485,417	18.19	27,013,343
North Dakota	183,332	28.89	5,296,461	610,923	17.55	10,719,863
Montana	53,951	36.20	1,953,026	1,059,045	19.42	20,563,797
Wyoming	19,391	32.96	639,127	804,021	19.60	15,760,416
Colorado	121,775	30.06	3,660,556	1,260,574	16.45	20,733,666
New Mexico	19,590	31.30	613,167	916,095	14.55	13,330,466
Arizona	18,856	35.91	677,119	556,841	17.30	9,633,401
Utah	69,496	30.93	2,149,511	251,783	17.39	4,378,504
Nevada	16,170	36.62	592,145	382,373	22.34	8,541,141
Idaho	57,327	31.28	1,793,189	351,226	17.97	6,310,761
Washington	154,454	33.41	5,160,308	297,513	19.08	5,676,810
Oregon	136,199	30.06	4,094,142	575,744	16.25	9,354,628
California	344,232	38.55	13,270,144	1,089,532	21.98	23,914,214
Oklahoma	188,616	21.05	3,970,367	1,351,999	14.06	19,011,943
Indian Territory	101,447	22.64	2,296,760	510,582	13.13	6,705,420
United States	17,419,817	29.21	508,841,489	43,629,498	16.32	712,178,134

Wholesale prices of cattle per 100 pounds, 1899 to 1903.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to prime.		Fair to medium.		Good to choice native steers.		Native beeves.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.					1,000 to	1,200 lbs.		
January	$2.00	$6.30	$3.25	$4.00	$4.25	$5.80	$3.75	$5.50
February	2.50	6.30	3.40	4.00	4.10	5.75	3.75	5.50
March	2.70	5.90	3.40	4.35	4.00	5.00	3.85	5.40
April	2.70	5.90	3.35	4.25	4.10	5.25	4.00	5.50
May	2.70	5.75	3.50	4.50	4.00	5.10	4.25	5.50
June	2.80	5.70	3.50	4.50	4.00	5.40	4.00	5.50
July	2.80	6.00	3.50	4.15	4.10	5.50	4.00	5.80
August	2.80	6.65	3.75	4.35	4.00	5.85	4.00	6.25
September	2.80	6.85	3.25	4.15	4.10	5.90	4.00	6.15
October	2.80	7.00	3.00	4.35	4.00	5.80	4.25	6.30
November	2.80	6.90	3.35	4.25	4.00	5.70	4.50	6.05
December	2.80	7.00	3.40	4.40	4.00	6.00	4.00	7.25
1900.					1,000 to	1,400 lbs.		
January	2.25	6.60	3.25	4.25	4.20	6.00	4.00	6.25
February	2.25	6.10	3.35	4.35	4.20	5.75	3.75	5.55
March	2.25	6.05	3.40	4.50	4.55	5.50	3.75	5.20
April	2.25	6.00	3.75	4.65	4.50	5.75	3.75	5.25
May	2.50	5.80	4.10	4.70	4.50	5.50	4.00	5.30
June	2.25	5.90	4.00	4.60	4.40	5.60	4.00	5.40
July	2.25	5.75	3.75	4.50	4.25	5.70	4.00	5.50
August	2.25	6.10	3.65	4.60	4.25	6.00	4.00	5.80
September	2.25	6.00	3.75	4.60	4.20	5.85	3.75	5.70
October	1.75	6.00	3.10	4.40	4.10	5.85	3.75	5.50
November	1.75	6.00	3.00	4.15	4.00	5.85	3.75	5.50
December	1.75	....	3.00	4.35	4.10	6.50	3.50	7.50
1901.								
January	2.70	6.15	3.25	4.35	4.75	5.60	3.50	5.35
February	2.70	6.10	3.15	4.15	4.75	5.65	3.50	5.30
March	2.70	6.25	3.15	4.25	4.75	5.60	3.75	5.40
April	2.70	6.10	3.35	4.60	4.75	5.85	3.75	5.45
May	2.70	6.10	3.60	4.65	4.80	6.00	3.75	5.60
June	2.70	6.55	3.75	4.40	5.00	6.00	4.00	5.90
July	2.20	6.55	3.25	4.25	4.75	6.35	4.00	5.75
August	2.20	6.35	3.00	4.50	5.00	6.35	4.00	5.90
September	2.20	6.60	3.15	4.25	5.00	6.40	4.00	6.25
October	2.20	6.85	3.00	4.25	5.50	6.75	4.00	6.40
November	2.10	6.90	3.00	4.15	5.50	7.00	4.00	7.25
December	2.10	7.00	3.25	4.60	5.50	8.25	3.50	6.85
1902.								
January	2.20	7.75	3.75	4.65	6.10	7.00	3.40	6.55
February	2.25	7.35	3.65	4.75	6.35	6.50	3.50	6.25
March	2.35	7.35	3.75	5.25	6.40	6.75	4.00	6.70
April	2.35	7.50	4.25	5.40	6.95	7.10	4.50	7.00
May	2.50	7.70	4.10	5.35	6.90	7.50	4.35	7.40
June	2.35	8.50	3.25	5.25	7.50	8.00	4.25	7.85
July	2.25	8.85	3.15	5.25	7.50	8.35	5.00	8.15
August	2.40	9.00	3.25	5.25	7.40	8.75	5.00	8.15
September	2.25	8.85	3.00	4.40	6.60	8.00	4.15	7.85
October	1.90	8.75	2.90	4.25	6.35	7.10	4.50	7.25
November	2.00	7.40	3.00	4.15	5.15	7.25	3.20	6.00
December	2.00	14.50	3.00	4.25	5.25	6.00	3.00	6.25
1903.								
January	2.00	6.85	3.15	4.35	5.10	5.75	3.35	5.10
February	2.35	6.15	3.10	4.25	5.10	5.25	3.15	5.15
March	2.50	5.75	3.35	4.40	5.10	5.40	3.45	5.35
April	2.50	5.80	3.75	4.40	5.10	5.60	3.20	5.25
May	2.50	5.65	3.25	4.40	5.00	5.50	3.85	5.10
June	2.25	5.65	3.00	4.40	5.10	5.25	3.75	5.30
July	2.25	5.65	2.85	4.10	5.15	5.35	3.65	5.35
August	2.15	6.10	2.50	4.00	5.25	5.55	3.85	5.75
September	2.00	6.15	2.25	3.75	5.60	5.70	3.60	5.75
October	1.65	6.00	2.50	3.65	5.40	5.55	3.90	5.50
November	1.50	5.85	2.35	3.40	5.15	5.40	3.00	5.30
December	1.50	8.35	2.35	3.75	5.10	6.00	2.65	5.30

Wholesale prices of butter per pound in leading cities of the United States, 1899–1903.

Date.	New York.		Cincinnati.		Chicago.		Elgin.	
	Creamery extra.		Creamery.		Creamery firsts.		Creamery extra.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	19	21	16	18	14	20½	18	20½
February	19	25	17	20	14	21½	20	22
March	20	22	19	20	17	21	20	20½
April	17	21½	18	19	14	21	17	20½
May	16½	19	16	17	14	18½	16	18
June	18	18½	17	18	16	18	18	18
July	17½	18½	16½	18	15½	18	17½	18
August	17½	21	16½	20	15½	20	18	20
September	20½	23	18	20	17½	22½	21	22½
October	23½	24	18	20	18	23	23½	23½
November	24	27	18	24	19	26	24½	26½
December	26½	28	21	24	21	27	26	27
1900.								
January	24	30	21	27	22	29	24	29
February	24	26	21	22	21	24½	24	24
March	23½	26	21	22	21	24½	24	24½
April	17½	23	16	20	15½	23½	18	22½
May	18½	19½	16	18	15½	19½	19½	19½
June	.....	.....	16	18	16½	19½	18	19½
July	19	20	17	18	17	19¼	19	19
August	18½	21	17	20	17	21	19½	21½
September	21	22	18	21	17½	21½	20½	21½
October	20½	22½	18	21	17	22	20½	22
November	22½	27	20	25	18	25½	22	26
December	25	26	23	24	20	24	24½	25
1901.								
January	21	25	18	21	15	23	21	24½
February	22	24	18	22	16	23	21	23½
March	22	23½	19	21	18	23	21½	23½
April	18	21	17	20	16	20½	20	21½
May	18	18	17	18	15½	18½	18½	18½
June	19	19½	17	19	16	19	18½	19
July	18	19	17	19	16	20	19	20
August	20	21	17	19	17	20½	20	21
September	20	22½	18	20	16	21	20	21
October	21	22½	20	21	17	22	21½	22
November	22½	25½	22	23	18	24½	22	24½
December	24	25½	22	23	20	24½	24½	24½
1902.								
January	23	26	22	23	20	24	24	24½
February	26	30	22	26	20	29	25½	29
March	27	30	23	24	22	28	26	28
April	22	33	23	27	18	31	22	30
May	22¼	25	19	20	19	23	22	22
June	21½	22½	19	20	18½	22	21	22
July	20½	21¾	18	21	18½	21½	20	21
August	19	20½	17	19	16	20	19	20
September	19½	23	17	21½	17	22½	19	22½
October	22½	25	20½	22½	19	24½	22½	24½
November	25	28½	21½	25	21½	27	24½	27
December	28	30	25	27	23	28½	28	29
1903.								
January	28½	28½	22	27	20	28	25	29
February	26	28	22	25	20	27½	25	27
March	27	29½	24½	26	24	28½	27½	28½
April	22½	29½	19½	26	21	28½	22½	28½
May	22	23	17½	20½	17	22	20	22½
June	20½	22½	18	21	18	22	20	22
July	19	20½	15½	20	17	20	18½	20
August	19	19¾	15½	18½	16	19	18½	19½
September	19¾	21¾	16½	20	17	21½	19½	21½
October	20	22¾	18	20	17	21½	20½	21½
November	22½	25½	19½	22½	18	24½	22	24
December	23	25½	21½	23½	19	25	24	25

Wholesale prices of cheese per pound in leading cities of the United States, 1899–1903.

Date.	New York.		Cincinnati.		Chicago.		St. Louis.	
	September, colored.		Factory.		Young Americas.		Full cream.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	10½	10½	10½	11½	10½	11	10½	11
February	10½	11	10½	11½	10½	11	11	11
March	11	12¼	11	12¼	10	12	11	11½
April	12	12¼	11½	12¼	11½	12¼	12½	12½
May	8½	12	9½	12	9¼	11¼	10½	12½
June	7½	8¾	8	10	7¾	9½	9	9¾
July	8	9½	8½	9½	8½	9	9¼	10¼
August	9¼	11¼	9	11	8¾	10	10¼	10½
September	11¼	11¾	10	12	10	11½	11¾	12½
October	12	12¾	12	12½	11	12¼	13	13
November	12½	12¾	12½	12½	11	12	12	13
December	12¾	13	12	12½	11	12½	12½	12½
1900.								
January	12¾	13	12	12½	9	12½	12½	12½
February	12¾	13¼	12	12½	9	12½	12½	12½
March	13¼	13½	12	12½	9	12½	12½	12½
April	11	13½	12	12½	8½	12½	12	12½
May	9¼	11	9	11½	8½	10	10	11¾
June	9¼	10	8½	9	8¾	10¼	10	10½
July	9	9½	8½	9½	8	10¼	10½	10¾
August	9¼	10⅝	8½	10½	8	11½	10¾	12
September	12	12¼	10	10½	10	11½	10¼	11½
October	10⅝	11⅜	10½	11½	10	11½	11¾	12
November	10¾	11	10¾	11	10	11¼	11½	11¾
December	11	11½	10¾	11	10¼	10¾	11½	11½
1901.								
January	11¼	12	11	12	10½	11½	11½	11½
February	12	12½	11½	12	11½	11½	11	11½
March	12	12½	11½	12	11	11¾	12	12
April	11½	12½	11	12	11½	11¾	11	12
May	8½	9½	8½	12	10½	11¾	10	11
June	9	9¾	8½	9½	9	10½	10	10¾
July	9	9½	8½	9½	9½	10¼	10	11¼
August	9⅝	9⅞	9	10	10	10½	11	11½
September	9½	10¼	9½	10	10	10¾	10½	11½
October	10¼	10¾	9½	10½	10	10¾	10½	11½
November	10¼	10¾	10	10½	9¾	10¼	10¾	11¼
December	10	11¼	10	10½	10	10¾	10¾	11¼
1902.								
January	11¼	11¾	10	11	10½	11¼	10¾	11½
February	11½	12½	10½	11½	10½	12½	12½	13
March	12¼	13¼	11	11½	11¾	12¼	13	14
April	13	13¼	11	12½	13	13	13¾	14½
May	10½	13	11½	12½	12¾	13½	12¾	14
June	9½	9¾	10½	12½	10¼	12¾	11	11½
July	9¾	10¼	10½	10½	10½	10¾	11½	11½
August	9½	10½	10½	10½	10½	11	11½	11¾
September	10⅜	12	10½	10½	10½	11¼	11¼	12
October	12	12½	11	12½	11¼	11¾	11¾	12½
November	12½	13	12	12½	11½	12	12¾	13½
December	13	13½	12	13	11½	13¼	13¾	14
1903.								
January	14	14	12½	12¾	13	13½	14	14¼
February	14½	14½	12½	12½	12½	13	14¼	14¼
March	14½	15	12½	12½	12½	13¼	14¼	14¼
April	15	15	12½	12½	12½	13¼	13½	14¼
May	11½	12¼	12½	12½	10½	13¾	12¾	14¾
June	10½	10¾	11	11¼	10½	10½	11½	11¾
July	10	10½	10½	10⅝	10	10¾	11¾	12
August	10¼	10½	10½	10½	9	11	11¾	12
September	10⅜	12¼	10½	10½	9½	11	11¾	12¼
October	11½	12¼	10½	10½	10	11	11¾	12¼
November	11½	12	10½	10½	10	10½	11½	11½
December	12	12	10½	10½	10	10	11½	11½

SHEEP AND WOOL.

Number and farm value of sheep, 1880–1904.

January 1—	Sheep.		January 1—	Sheep.	
	Number.	Value.		Number.	Value.
1880	40,765,900	$90,230,537	1893	47,273,553	$125,909,264
1881	43,569,899	104,070,759	1894	45,048,017	89,186,110
1882	45,016,224	106,595,954	1895	42,294,064	66,685,767
1883	49,237,291	124,366,335	1896	38,298,783	65,167,735
1884	50,626,626	119,902,706	1897	36,818,643	67,020,942
1885	50,360,243	107,960,650	1898	37,656,960	92,721,133
1886	48,322,331	92,443,867	1899	39,114,453	107,697,530
1887	44,759,314	89,872,839	1900	41,883,065	122,665,913
1888	43,544,755	89,279,926	1901	59,756,718	178,072,476
1889	42,599,079	90,640,369	1902	62,039,091	164,446,091
1890	44,336,072	100,659,761	1903	63,964,876	168,315,750
1891	43,431,136	108,397,447	1904	51,630,144	133,530,099
1892	44,938,365	116,121,290			

Number, average price, and farm value of sheep in the United States on January 1, 1904.

States and Territories.	Number.	Average farm price, Jan. 1.	Value.	States and Territories.	Number.	Average farm price, Jan. 1.	Value.
Maine	313,982	$2.84	$893,153	Indiana	1,233,447	$3.45	$4,249,472
New Hampshire	82,605	2.83	233,392	Illinois	820,184	3.55	2,910,751
Vermont	246,488	2.83	697,117	Wisconsin	1,355,341	2.94	3,981,721
Massachusetts	44,855	4.27	191,424	Minnesota	513,337	2.61	1,340,631
Rhode Island	8,834	3.69	32,576	Iowa	862,118	3.31	2,856,886
Connecticut	34,254	4.54	155,532	Missouri	778,121	2.90	2,254,683
New York	1,313,974	3.84	5,042,638	Kansas	263,219	2.97	781,312
New Jersey	41,685	4.08	182,439	Nebraska	493,340	2.79	1,376,664
Pennsylvania	963,421	3.53	3,402,129	South Dakota	927,246	2.71	2,509,221
Delaware	11,946	4.03	48,199	North Dakota	836,059	2.69	2,252,008
Maryland	163,564	3.64	594,686	Montana	5,270,063	2.31	12,184,386
Virginia	572,314	2.98	1,705,611	Wyoming	4,602,658	2.58	11,883,603
North Carolina	203,027	1.98	401,425	Colorado	1,846,518	2.25	4,152,265
South Carolina	59,452	1.97	117,311	New Mexico	3,860,466	1.93	7,464,598
Georgia	276,660	1.72	476,298	Arizona	1,088,188	2.18	2,375,841
Florida	110,955	2.15	238,909	Utah	2,391,947	2.29	5,468,230
Alabama	195,773	1.83	358,500	Nevada	879,602	2.48	2,185,283
Mississippi	187,489	1.68	314,907	Idaho	3,588,034	2.21	7,913,050
Louisiana	176,655	1.89	333,012	Washington	894,335	2.78	2,490,633
Texas	1,667,139	1.97	3,285,431	Oregon	2,927,198	2.04	5,976,461
Arkansas	198,704	1.65	327,027	California	2,271,249	2.75	6,237,758
Tennessee	300,378	2.24	671,584	Oklahoma	64,242	2.58	165,686
West Virginia	648,951	3.08	1,995,784	Indian Territory	25,295	2.11	53,488
Kentucky	719,779	2.71	1,948,441				
Ohio	3,171,963	3.20	10,158,528	United States	51,630,144	2.59	133,530,099
Michigan	2,120,090	3.14	6,659,415				

Imports and exports of sheep, with average prices, 1892–1903.

Year ended June 30—	Imports.			Exports.		
	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	380,814	$1,440,530	$3.78	46,960	$161,105	$3.43
1893	459,484	1,682,977	3.66	37,260	126,394	3.39
1894	242,568	788,181	3.25	132,370	832,763	6.29
1895	291,461	682,618	2.34	405,748	2,630,686	6.48
1896	322,692	853,530	2.65	491,565	3,076,384	6.26
1897	405,633	1,019,668	2.51	244,120	1,531,645	6.27
1898	392,314	1,106,322	2.82	199,690	1,213,886	6.08
1899	345,911	1,200,081	3.47	143,286	853,555	5.96
1900	381,792	1,365,026	3.58	125,772	733,477	5.83
1901	331,488	1,236,277	3.73	297,925	1,933,000	6.49
1902	266,953	956,711	3.58	358,720	1,940,060	5.41
1903	301,623	1,036,934	3.44	176,961	1,067,860	6.03

Prices of sheep per 100 pounds in leading cities of the United States, 1899–1903.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to choice.		Good to extra.		Good to choice natives.		Native.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.								
January	$2.50	$4.30	$3.10	$4.00	$3.50	$4.25	$3.25	$4.75
February	2.80	4.55	3.35	4.25	3.50	4.50	3.25	4.50
March	2.90	5.10	3.40	4.25	3.75	4.75	3.25	5.00
April	3.25	5.10	4.00	5.00	4.00	5.15	3.50	5.00
May	3.50	5.65	4.00	5.00	4.25	5.60	3.50	5.50
June	3.25	5.55	3.40	4.35	3.75	5.35	3.00	5.25
July	3.00	5.40	3.00	4.25	4.00	4.75	3.00	4.75
August	2.75	5.40	2.85	4.35	3.50	4.10	3.50	4.50
September	2.75	4.70	3.00	4.00	3.50	4.25	3.25	4.40
October	2.90	4.40	3.00	4.85	3.00	4.20	3.00	4.40
November	2.75	4.50	3.00	3.90	3.10	4.50	3.00	4.60
December	2.75	4.80	3.00	3.90	3.25	5.10	2.75	4.60
1900.								
January	2.75	5.25	3.35	4.75	4.00	5.25	3.25	5.25
February	3.25	5.85	4.00	5.75	4.75	5.50	3.50	5.75
March	4.00	6.00	5.00	6.00	5.25	5.75	3.50	6.10
April	4.25	6.50	5.00	6.00	5.25	6.25	3.50	6.10
May	3.75	6.50	3.00	4.75	4.50	5.50	3.50	6.00
June	3.25	5.70	2.75	4.50	4.25	4.75	3.25	5.25
July	2.75	5.15	2.25	4.25	3.90	4.30	3.00	4.60
August	2.60	4.70	2.00	4.25	3.50	4.25	3.00	4.60
September	2.50	4.25	2.00	3.90	3.40	4.00	2.50	4.00
October	2.50	4.25	1.50	4.00	3.50	4.00	2.00	4.00
November	2.50	4.35	1.25	3.75	3.50	4.00	2.00	4.25
December	2.50	5.00	1.25	3.75	3.65	4.25	2.25	4.35
1901.								
January	2.75	4.75	2.75	4.25	3.75	4.50	3.00	4.90
February	2.75	4.75	3.25	4.25	4.00	4.50	3.00	4.75
March	2.75	5.00	3.25	4.50	4.00	5.10	3.00	4.85
April	3.00	5.15	3.75	4.50	4.25	5.10	3.00	5.00
May	2.75	5.00	3.65	4.25	4.00	4.75	2.50	4.40
June	2.75	4.70	3.00	4.00	3.25	4.60	2.25	4.25
July	2.65	4.40	3.00	3.65	3.00	3.75	2.25	4.65
August	2.65	4.05	2.40	3.65	3.00	3.75	2.00	3.60
September	2.75	4.00	2.25	3.40	3.00	3.65	2.00	3.60
October	2.75	4.40	2.15	3.15	3.10	3.50	2.25	4.25
November	2.50	4.30	2.15	3.00	3.15	3.75	2.25	3.75
December	2.50	4.50	2.40	3.60	3.25	4.00	2.50	4.50
1902.								
January	2.00	4.75	3.00	4.25	4.25	5.00	4.00	5.15
February	2.00	5.50	3.50	5.50	4.75	5.60	4.20	5.85
March	3.00	5.75	4.25	5.50	5.50	5.75	4.40	5.90
April	2.50	6.50	3.75	5.50	5.50	6.25	4.75	6.25
May	2.25	6.50	4.35	5.75	6.00	6.35	5.40	6.00
June	1.50	6.25	3.50	4.60	3.70	5.60	4.50	6.00
July	1.75	5.00	3.10	4.00	4.00	4.60	3.80	4.50
August	1.50	4.25	2.25	4.00	3.85	4.35	....	....
September	1.50	4.50	2.00	3.40	3.65	4.00	2.00	3.40
October	1.50	4.25	2.65	3.40	3.90	4.00	3.00	4.10
November	1.50	4.25	2.50	3.35	3.75	4.00	3.40	4.25
December	1.25	4.75	2.75	4.00	3.80	4.50	3.50	4.75
1903.								
January	1.50	5.25	3.25	4.50	4.50	5.00	3.60	5.40
February	2.00	5.75	3.75	5.00	5.25	5.25	4.50	5.80
March	2.00	7.00	4.25	6.00	5.50	6.15	4.60	6.75
April	2.25	7.00	4.10	6.25	6.00	6.25	4.50	6.75
May	1.60	6.25	3.60	4.75	4.50	5.25	4.00	5.50
June	2.00	6.00	3.00	4.50	4.50	4.75	3.80	5.50
July	1.50	5.25	2.90	4.00	3.75	4.75	3.00	4.50
August	1.50	4.25	2.75	3.35	3.50	3.85	3.00	4.00
September	1.50	4.25	2.60	3.40	3.65	4.00	3.50	3.50
October	1.50	4.25	2.75	3.50	3.65	4.00	3.55	3.55
November	1.25	4.35	2.60	3.35	3.60	3.65	3.25	4.00
December	1.50	4.25	2.60	3.75	3.65	3.85	3.25	4.40

Wool product of the United States for 1903, by States.

[Estimates of Mr. S. N. D. North.]

States and Territories.	Number of sheep Apr. 1, 1903.	Average weight of fleece, 1903.	Per cent of shrinkage, 1903.	Wool, washed and unwashed.	Wool, scoured.
		Pounds.		*Pounds.*	*Pounds.*
Maine	230,000	6	40	1,380,000	828,000
New Hampshire	63,000	6.2	50	390,600	195,300
Vermont	160,000	6	50	960,000	480,000
Massachusetts	33,000	5.8	45	191,400	105,270
Rhode Island	6,500	5.5	42	35,750	20,735
Connecticut	30,000	5	40	150,000	90,000
New York	700,000	6	50	4,200,000	2,100,000
New Jersey	32,000	5	47	160,000	84,800
Pennsylvania	850,000	6	52	5,100,000	2,448,000
Delaware	6,500	6	50	39,000	19,500
Maryland	100,000	5	47	500,000	265,000
Virginia	325,000	4.5	38	1,462,500	906,750
North Carolina	205,000	4	42	820,000	475,600
South Carolina	50,000	4	42	200,000	116,000
Georgia	250,000	3.8	40	950,000	570,000
Florida	100,000	3.8	42	380,000	220,400
Alabama	200,000	3.7	40	740,000	444,000
Mississippi	230,000	4	42	920,000	533,600
Louisiana	155,000	3.7	45	573,500	315,425
Texas	1,440,000	6.25	68	9,000,000	2,880,000
Arkansas	160,000	4	42	640,000	371,200
Tennessee	275,000	4.50	40	1,237,500	742,500
West Virginia	475,000	5.3	46	2,517,500	1,359,450
Kentucky	600,000	4.75	38	2,850,000	1,767,000
Ohio	2,200,000	5.6	52	12,320,000	5,913,600
Michigan	1,400,000	6.5	50	9,100,000	4,550,000
Indiana	750,000	6.5	50	4,875,000	2,437,500
Illinois	550,000	7	52	3,850,000	1,848,000
Wisconsin	750,000	6.5	48	4,875,000	2,535,000
Minnesota	350,000	6.8	52	2,380,000	1,142,400
Iowa	600,000	6.5	50	3,900,000	1,950,000
Missouri	575,000	6.5	50	3,737,500	1,868,750
Kansas	170,000	7.5	67	1,275,000	420,750
Nebraska	300,000	7.5	67	2,250,000	742,500
South Dakota	600,000	6.5	60	3,900,000	1,560,000
North Dakota	475,000	6.5	60	3,087,500	1,235,000
Montana	5,100,000	6	63	30,600,000	11,322,000
Wyoming	4,100,000	7	68	28,700,000	9,184,000
Colorado	1,300,000	6.5	66	8,450,000	2,873,000
New Mexico	3,250,000	5	60	16,250,000	6,500,000
Arizona	675,000	6.5	67	4,387,500	1,447,875
Utah	2,250,000	5.75	64	12,937,500	4,657,500
Nevada	568,000	7	70	3,976,000	1,192,800
Idaho	2,400,000	7	67	16,800,000	5,544,000
Washington	560,000	8.5	70	4,760,000	1,428,000
Oregon	2,000,000	7.75	70	15,500,000	4,650,000
California	1,625,000	7.25	68	11,781,250	3,770,000
Oklahoma and Indian Territory	60,000	6	68	360,000	115,200
United States	39,284,000	6.25	60.8	245,450,000	96,226,405
Pulled wool			33	42,000,000	28,140,000
Total product, 1903				287,450,000	124,366,405

Range of prices of wool in Boston, monthly, 1899-1903.[a]

[Cents per pound.]

Date.	Ohio fine, unwashed.		Indiana quarter-blood, unwashed.		Ohio XX, washed.		Ohio, No. 1, washed.		Ohio Delaine, washed.		Michigan X, washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.												
January	18	19	20	21	27	27	29	29	28	29	21	21
February	18	18½	21	21	26½	27	29	29	28	28½	21	21
March	16	17	20	21	25½	26	28½	29	27	28	20	21
April	17	18	21	22	26	26½	29	29	28	28	21	21
May	18	19	22	23	27	27½	29	29	28	29	21	22
June	19	19	22	23	27½	28	29	30	29	31	22	23
July	20	23	23	23	29	32	31	33	32	34	23	25
August	21	23	22	23	31	32	33	34	31	35	24	25
September	22	24	23	24	32	32	34	34	35	35	25	25
October	24	24	24	24	32	33	35	35½	35	36	25	25½
November	24	25	25	26	33	37	35½	37	36	40	26	30
December	25	26	27	28	37	38	37	39	40	40	29	30
1900.												
January	25	26	28	29	37	38	38	39	38	40	29	29
February	25	25	28	29	37	37	38	38	38	38	28	29
March	22	23	27	28	34	36	35	37	35	37½	24	27
April	21	22	26	27	32	34	35	35	35	35	24	24
May	20	21	25	26	31	32	31	35	33	35	24	24
June	19	20	25	25	29	31	32	33	32	33	23	24
July	19	19	24	25	29	29	31	32	31	32	23	23
August	19	19	23	24	28	29	30	31	29	31	22	23
September	18	19	23	24	27½	28	30	30	29	29	22	22
October	18	19	23	24	27	27½	28	29	27½	28	21½	22
November	18	19	23	24	27	28	28	29	28	30	22	23
December	18	18	23	24	28	28	28	28	29	29	22	22½
1901.												
January	17	18	23	23½	27	28	28	29	29	30	22	22
February	16½	17	23	24	27	27	27½	28	28	30	21	22
March	16½	18	22½	23	26	27	26	27	29	30	21	21
April	17	18	22	22½	26½	26½	26	27	28	30	21	21
May	17	17	20	21	26	26	25	26	28	30	20	20
June	17½	18	19½	20	26	26½	25	26	28	29	20	20½
July	18	18	20	20	26½	27	26	26	28	30	21	21½
August	18	18½	20	20	27	27	26½	26½	28	30	20½	21
September	18½	18½	20½	20½	26	27	26	26½	28	28½	21	21
October	18½	18½	20	20	26	26	25	26	28	28	20	21
November	19	19	20	21½	26	27	26	26½	27½	29	21	21
December	19	19½	21½	22	26½	27	26	27	28	29	21	21
1902.												
January	19½	20	22	22	27	27	27	27	28	29	21	21
February	20	20	22	22	27	27	27	27	28	29	21	21
March	19½	19½	21½	22	27	27	26½	27	28	29	21	21
April	19½	19½	21½	21½	27	27	26½	26½	28	28½	20½	21½
May	19	19½	20½	20½	27	27	26	26	28	28½	21	22
June	19	20	20½	21	27	27½	26	26	28	29	22	22
July	20	20	21	22	27	28	26	27	28	31	22	22
August	20	21	22	23	28	28	28	29	30	33	22	23
September	21½	21½	22	23	29	29	29	30	31½	32	23	23
October	21½	21½	23	23	30	30	30	30	31½	32	23	24
November	21½	22	23	23	29	31	30	31	31½	33	24	25
December	23	23	24	24	32	32	31	31	33	35	26	27
1903.												
January	22	23	23½	24	32	32½	31	32	34	35	27	27½
February	22	23	24	25	31	33	31	33	34	35	27	27½
March	22	23	22	24	31	32	31	32	33½	34	26	27
April	20	22	22	23½	31	32	30	31	33½	34	26	26½
May	20	22	22	23½	30	32	29	31	33½	35	25	26
June	21	24	22	25	31	34	30	33	34	37	25	26
July	23	24	23	25	33	34	32	33	36	37	[b]21	22
August	23	25	21	25	33	35	32	33	36	37	21½	22
September	24	25	24	25	34	35	32	33	36	37	21	22
October	24	25	24	25	34	35	32	34	36	37	21	22
November	24	25	24	25	34	35	33	34	35	37	21	22
December	24	25	24	25	34	35	33	34	35	36	21	22

[a] Furnished by Commercial Bulletin, Boston.
[b] Since June 12 the standard quotation has been Michigan fine unwashed.

Range of prices of wool in Boston, monthly, 1899–1903—Continued.

[Cents per pound.]

Date.	Fine selected Territory, staple scoured. Low.	Fine selected Territory, staple scoured. High.	Fine medium Territory, clothing scoured. Low.	Fine medium Territory, clothing scoured. High.	Texas, 12 months, scoured. Low.	Texas, 12 months, scoured. High.	Fine free fall, Texas or California scoured. Low.	Fine free fall, Texas or California scoured. High.	Pulled, A super, scoured. Low.	Pulled, A super, scoured. High.	Pulled, B super, scoured. Low.	Pulled, B super, scoured. High.
1899.												
January	45	46	40	42	42	44	32	33	40	41	32	33
February	41	45	40	40	42	43	32	33	40	42	32	34
March	42	45	38	40	40	42	30	32	40	40	30	31
April	45	45	40	40	41	42	32	33	40	42	31	34
May	45	47	40	42	43	46	33	37	41	44	33	37
June	48	52	43	47	47	50	38	41	42	45	34	37
July	53	58	48	51	51	55	42	45	44	47	36	38
August	55	58	50	52	53	55	43	45	45	47	36	38
September	56	63	51	55	54	56	44	46	46	48	37	40
October	62	63	54	55	56	58	44	46	47	48	40	42
November	63	72	56	62	59	63	46	52	48	52	43	50
December	72	75	60	62	63	65	50	52	53	57	50	52
1900.												
January	73	74	60	62	63	65	52	55	55	57	48	50
February	68	70	58	60	60	62	50	52	55	56	48	49
March	65	67	55	57	58	60	47	50	50	54	46	48
April	63	65	53	55	57	58	47	48	50	52	40	45
May	60	62	51	53	56	57	46	48	47	50	40	42
June	55	60	50	51	53	55	42	46	47	50	40	42
July	53	55	46	50	52	53	41	42	46	47	39	40
August	52	53	46	48	52	52	40	42	45	46	37	40
September	50	52	45	47	50	52	38	40	45	45	36	38
October	50	50	45	45	50	50	38	40	42	45	36	38
November	50	52	45	47	50	50	38	40	43	46	37	40
December	49	50	45	46	48	50	40	40	45	46	37	39
1901.												
January	50	50	39	43	48	48	38	40	42	45	37	38
February	48	50	38	39	47	50	37	40	40	45	35	35
March	43	45	35	38	43	45	36	38	38	42	34	35
April	45	47	38	40	43	47	36	37	38	40	33	34
May	45	47	40	40	45	47	36	37	35	38	31	32
June	45	47	40	42	45	47	36	37	35	39	30	30
July	46	48	42	43	47	50	36	40	37	40	31	33
August	47	50	43	44	48	50	40	40	38	40	33	33
September	49	50	44	44	50	50	40	40	38	40	33	33
October	49	50	42	44	50	50	40	40	38	40	32	32
November	49	50	43	44	48	50	40	42	38	40	32	33
December	49	50	43	44	48	50	40	42	38	40	34	34
1902.												
January	49	55	44	47	48	50	40	42	38	42	34	36
February	54	55	46	47	48	55	40	45	38	42	36	36
March	50	55	45	46	52	55	40	45	38	42	35	36
April	50	52	44	44	52	53	40	42	38	42	33	33
May	50	52	42	45	48	52	38	40	38	41	33	34
June	48	52	42	44	50	55	38	40	38	42	34	35
July	50	55	45	47	52	57	38	40	38	45	36	38
August	55	57	47	49	55	57	40	40	42	45	39	39
September	55	57	49	49	55	57	40	40	40	45	37	38
October	55	57	49	49	55	57	40	45	40	45	37	37
November	55	58	49	50	55	60	44	48	40	44	37	39
December	58	59	50	50	57	60	46	48	44	46	40	40
1903.												
January	56	60	54	58	57	60	46	48	44	46	40	42
February	55	58	52	56	55	58	45	48	43	46	40	43
March	54	56	52	54	55	57	45	46	42	45	39	42
April	54	55	52	53	55	57	45	46	40	44	39	41
May	52	55	50	53	53	57	45	46	40	45	39	42
June	52	55	50	53	53	57	45	48	42	46	40	42
July	53	55	52	53	55	57	46	48	43	47	40	44
August	54	56	52	53	55	57	46	48	45	47	43	44
September	55	56	52	53	55	57	46	48	44	47	42	44
October	55	56	52	53	55	57	46	48	44	47	42	43
November	53	56	51	53	55	56	45	48	44	47	40	43
December	53	55	51	52	55	56	44	46	43	45	40	42

Wholesale prices of wool per pound in leading cities of the United States, 1899–1903.

Date.	Boston. XX Ohio, washed.		New York. XX Ohio.		Philadelphia. XX Ohio, washed.		St. Louis. Best tub-washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	27	27	28	29	27	28	26	26
February	26½	27	28	29	26½	27	26	26
March	25½	26	28	29	26½	27	25½	26
April	26	26½	28	29	26	27	26	26
May	27	27½	28	29	25½	26½	26	26½
June	27½	28	28	29	27	28	27	27
July	29	32	28	29	28½	30	26	26½
August	31	32	30	32	29	31	26½	27
September	32	32	30	32	31	32	26½	27½
October	32	33	30	33	32½	33½	28	28½
November	33	37	32	36	33	34	29	32
December	37	38	36	39	35	36	34	35
1900.								
January	37	38	36	39	36	37	29	35
February	37	37	36	39	36	37	35	36
March	34	36	36	39	36	37	33	35
April	32	34	36	37	34	35	33	34
May	31	32	34	37	33	34	33	34
June	29	31	34	36	30	32	28	32½
July	29	29	28	36	29	32	28	29
August	28	29	28	30	29	30	29	29
September	27½	28	28	30	28	30	29	29
October	27	27½	28	30	28	29	29	29
November	27	28	28	30	27	28	29	29½
December	28	28	28	30	27	28	29	29½
1901.								
January	27	28	26½	27	27	28	28	29½
February	27	27	26	26½	27	28	27	28
March	26	27	25½	26	26	27	27	27½
April	26½	26½	25½	26	25	27	27	27
May	26	26	25½	25½	25	27	25	27
June	26	26½	25½	25½	25	27	24	25
July	26½	27	25½	25½	25	26	......	......
August	27	27	25½	25½	26	27	24	24
September	26	27	25½	25½	26	27	24	25
October	26	26	25½	25½	26	27	24	24
November	26	27	25½	25½	26	27	24	25
December	26½	27	25½	25½	26	27	24	24½
1902.								
January	27	27	26	27	26	27	24	24½
February	27	27	26	27	26	27	24½	24½
March	27	27	26	27½	26	27	24	24
April	27	27	26½	27½	26	27	24	24
May	27	27	26½	27½	26	27	24	25
June	27	27½	26½	27½	26	27	24	25
July	27	28	26½	27½	26½	27½	24	25½
August	28	28	26½	27½	27½	28	25½	26½
September	29	29	26½	27½	27	29	26	26½
October	30	30	....	....	27	29	26	27
November	29	31	28	29	29	30	27½	28½
December	32	32	30	32	31	32	28	29
1903.								
January	32	32½	31	32	31	32	29	29
February	31	33	31	32	31	32	29	29
March	31	32	31	32	31	32	28	29
April	31	32	31	32	31	32	27	28½
May	30	32	30	33	31	32	27	28½
June	31	34	30	31	30	31	28	29
July	33	34	30	31	32	33	29	29½
August	33	35	31	33	32	33	29	29½
September	34	35	28	32	32	33	30	30
October	34	35	28	32	33	34	30	30½
November	34	35	28	32	33	34	30½	31
December	34	35	28	32	33	34	30½	30½

HOGS.

Number and farm values of hogs, 1880 to 1904, with exports.

Year.	On farms, January 1.			Exports for year ended June 30.		
	Number.	Value.	Average farm value.	Number.	Value.	Average price.
1880	34,034,100	$145,781,515	$4.28	83,434	$421,089	$5.05
1881	36,247,683	170,535,435	4.70	77,456	572,138	7.39
1882	44,122,200	263,543,195	5.97	36,368	509,651	14.01
1883	43,270,086	291,951,221	6.75	16,129	272,516	16.90
1884	44,200,893	246,301,139	5.57	46,382	627,480	13.53
1885	45,142,657	226,401,683	5.02	55,025	579,183	10.53
1886	46,092,043	196,569,894	4.26	74,187	674,297	9.09
1887	44,612,836	200,043,291	4.48	75,383	564,753	7.49
1888	44,346,525	220,811,082	4.98	23,755	193,017	8.13
1889	50,301,592	291,307,193	5.79	45,128	356,764	7.91
1890	51,602,780	243,418,336	4.72	91,148	909,042	9.97
1891	50,625,106	210,193,923	4.15	95,654	1,146,630	11.99
1892	52,398,019	241,031,415	4.60	31,963	364,081	11.39
1893	46,094,807	295,426,492	6.41	27,375	397,162	14.51
1894	45,206,498	270,384,626	5.98	1,553	14,753	9.50
1895	44,165,716	219,501,267	4.97	7,130	72,424	10.16
1896	42,842,759	186,529,745	4.35	21,049	227,297	10.80
1897	40,600,276	166,272,770	4.10	28,751	295,998	10.30
1898	39,759,993	174,351,409	4.39	14,411	110,487	7.67
1899	38,651,631	170,109,743	4.40	33,031	227,241	6.88
1900	37,079,356	185,472,321	5.00	51,180	394,813	7.71
1901	56,982,142	353,012,143	6.20	22,318	238,465	10.68
1902	48,698,890	342,120,780	7.03	8,368	88,330	10.56
1903	46,922,624	364,973,688	7.78	4,031	40,923	10.15
1904	47,009,367	289,224,627	6.15			

Number, average price, and farm value of hogs in the United States on January 1, 1904.

States and Territories.	Hogs.			States and Territories.	Hogs.		
	Number.	Average farm price, Jan. 1.	Farm value.		Number.	Average farm price, Jan. 1.	Farm value.
		Dollars.	*Dollars.*			*Dollars.*	*Dollars.*
Maine	65,355	8.76	572,510	Indiana	2,658,051	6.17	16,400,175
New Hampshire	49,723	10.40	517,119	Illinois	3,710,020	6.82	25,302,336
Vermont	89,510	9.06	810,961	Wisconsin	1,670,016	7.76	12,959,324
Massachusetts	70,510	9.46	667,025	Minnesota	1,219,770	7.16	8,733,553
Rhode Island	12,203	13.08	159,615	Iowa	7,364,268	6.39	47,057,673
Connecticut	46,501	11.92	554,292	Missouri	3,142,002	5.30	16,652,611
New York	682,437	9.52	6,496,800	Kansas	1,856,935	6.53	12,125,786
New Jersey	154,069	11.35	1,748,683	Nebraska	2,860,242	6.43	18,391,356
Pennsylvania	1,000,082	9.03	9,030,740	South Dakota	820,416	6.73	5,521,400
Delaware	44,681	8.20	366,384	North Dakota	184,173	7.79	1,434,708
Maryland	293,257	7.65	2,243,416	Montana	54,850	9.06	496,941
Virginia	759,567	5.00	3,797,835	Wyoming	15,823	7.96	125,951
North Carolina	1,047,669	4.84	5,070,718	Colorado	74,382	7.56	562,328
South Carolina	651,870	5.64	3,676,547	New Mexico	22,238	7.90	175,680
Georgia	1,411,032	5.25	7,407,918	Arizona	18,368	7.29	133,903
Florida	387,617	3.48	1,348,907	Utah	56,818	8.20	465,908
Alabama	1,013,816	4.34	4,399,961	Nevada	14,300	7.79	111,397
Mississippi	1,045,942	4.99	5,219,251	Idaho	116,023	6.37	739,067
Louisiana	649,372	4.93	3,201,404	Washington	179,513	7.98	1,432,514
Texas	2,404,808	5.19	12,480,954	Oregon	274,421	5.75	1,577,921
Arkansas	1,074,214	4.08	4,382,793	California	526,650	6.55	3,449,558
Tennessee	1,053,663	4.79	5,047,046	Oklahoma	491,429	5.84	2,869,945
West Virginia	312,713	5.46	1,707,413	Indian Territory	701,805	4.71	3,305,502
Kentucky	948,509	4.27	4,050,133				
Ohio	2,728,535	6.25	17,053,344	United States	47,009,367	6.15	289,224,627
Michigan	979,199	7.34	7,187,321				

Wholesale prices of live hogs per 100 pounds in leading cities of the United States, 1899–1903.

Date.	Cincinnati. Packing, fair to good.		St. Louis. Mixed packers.		Chicago.		Omaha.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.								
January	\$3.45	\$3.95	\$3.40	\$3.90	\$3.30	\$4.05	\$3.30	\$3.75
February	3.55	4.05	3.55	4.00	3.45	4.05	3.30	3.77
March	3.60	3.95	3.55	3.97½	3.50	4.00	3.40	3.75½
April	3.70	4.00	3.65	4.12½	3.50	4.15	3.50	3.85
May	3.65	3.92	3.60	3.95	3.45	4.05	3.45	3.80
June	3.65	4.00	3.60	3.90	3.45	4.00	3.25	3.75
July	3.80	4.65	3.75	4.60	3.55	4.70	3.67½	4.42
August	4.35	4.85	4.55	4.85	3.85	5.00	4.10	4.70½
September	4.25	4.80	4.45	4.75	3.90	4.90	4.10	4.52
October	4.15	4.75	4.10	4.65	3.80	4.90	3.95	4.57½
November	3.75	4.20	3.75	4.20	3.55	4.35	3.60	4.12½
December	3.75	4.40	3.80	4.47½	3.55	4.45	3.70	4.20½
1900.								
January	4.45	4.80	4.40	4.75	3.70	4.92½	4.15	4.72½
February	4.85	5.05	4.75	5.05	3.70	5.10	4.40	4.90
March	4.95	5.25	4.85	5.45	4.00	5.52½	4.50	5.17½
April	5.25	5.85	5.45	5.75	4.25	5.85	5.00	5.62½
May	5.15	5.45	5.20	5.50	4.00	5.57½	4.50	5.40
June	5.00	5.30	5.00	5.35	4.10	5.42½	4.57½	5.25
July	5.25	5.55	5.30	5.50	4.25	5.55	4.75	5.25
August	5.25	5.40	5.25	5.50	3.60	5.57½	4.75	5.25
September	5.40	5.60	5.35	5.60	3.50	5.70	4.90	5.35
October	4.45	5.30	4.75	5.40	3.35	5.55	4.25	5.25
November	4.45	5.00	4.70	5.00	3.40	5.10	4.30	4.97½
December	4.60	5.15	4.75	4.95	4.00	5.45	4.55	5.00
1901.								
January	4.95	5.40	4.90	5.30	4.25	5.47½	4.90	5.35
February	5.20	5.75	5.05	5.45	5.10	5.65	5.10	5.42½
March	5.60	6.05	5.25	6.10	4.90	6.20	5.17½	6.00
April	5.65	6.20	5.60	6.15	4.40	6.25	5.50	6.10
May	5.60	5.95	5.50	5.90	4.15	5.97½	5.00	5.82½
June	5.75	6.20	5.70	6.25	4.25	6.30	5.50	6.07½
July	5.70	6.20	5.80	6.20	3.00	6.35	5.25	6.02½
August	5.85	6.80	5.75	6.60	3.00	6.60	5.05	6.45
September	6.75	7.20	6.60	7.10	3.00	7.40	5.85	6.90
October	5.70	6.95	5.90	7.00	4.25	7.10	5.60	6.85
November	5.35	5.70	5.45	6.10	3.75	6.30	4.45	6.15
December	5.80	6.40	6.00	6.50	4.00	6.70	5.40	6.80
1902.								
January	6.00	6.50	6.10	6.90	4.40	6.85	5.40	6.70
February	6.05	6.50	5.85	6.50	4.40	6.85	5.25	6.45
March	6.20	6.95	5.80	6.92½	4.75	7.00	5.50	6.75
April	6.75	7.30	6.80	7.50	5.40	7.50	6.20	7.30
May	6.65	7.25	6.70	7.50	5.40	7.50	6.50	7.35
June	6.70	7.70	6.95	7.95	5.65	7.95	6.70	7.75
July	7.25	8.00	7.50	8.15	5.70	8.75	6.85	8.05
August	6.40	7.70	6.70	8.12½	5.30	7.95	6.50	7.65
September	6.90	7.80	7.30	8.20	5.50	8.20	7.05	7.75
October	6.50	7.70	6.40	7.90	4.50	7.90	6.40	7.45
November	5.85	6.60	6.05	6.90	4.60	6.95	5.95	6.55
December	6.05	6.65	5.95	6.70	4.60	6.85	5.75	6.60
1903.								
January	6.25	6.95	6.15	6.95	5.00	7.00	6.00	6.85
February	6.70	7.30	6.60	7.30	5.30	7.55	6.35	7.20
March	7.05	7.75	6.95	7.60	6.00	7.85	6.75	7.55
April	6.70	7.45	6.50	7.40	6.30	7.65	6.60	7.40
May	5.75	6.85	5.80	7.05	5.10	7.15	5.50	6.90
June	5.70	6.25	5.50	6.20	5.25	6.35	5.50	6.20
July	5.15	5.90	5.30	5.95	4.60	6.20	4.90	5.65
August	5.40	6.05	5.20	5.90	4.50	6.15	4.92½	5.80
September	5.80	6.35	5.55	6.20	4.85	6.45	5.05	6.00
October	5.10	6.20	5.30	6.25	4.00	6.50	4.80	5.85
November	4.15	5.35	4.50	5.50	3.75	5.50	4.10	5.25
December	4.25	4.95	4.20	4.85	3.80	4.90	4.15	4.70

Monthly average prices of live hogs in Chicago. [a]

[In dollars per 100 pounds.]

Month.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	4.22½	7.45	5.27½	4.25	3.90	3.30	3.67½	3.67½	4.53¾	5.13¾	6.20	6.40
February	4.57½	7.97½	5.07½	4.12½	3.97½	3.42½	3.93¾	3.75	4.82½	5.37½	6.00	6.80
March	4.55	7.55	4.72½	4.57½	3.90	3.80	3.91¼	3.75	5.07½	5.70	6.32½	7.18¾
April	4.50	7.02½	4.97½	4.91¼	3.60	3.87½	3.87½	3.82½	5.47½	5.90	6.92½	7.12½
May	4.55	7.40	4.87½	4.53¾	3.27½	3.65	4.25	3.75	5.23¾	5.75	6.95	6.28¾
June	4.97½	6.62½	4.75	4.65	3.15	3.37½	4.02½	3.72½	5.13¾	5.92½	7.30	6.00
July	5.65	5.60	5.30	5.10	3.10	3.52½	3.88¾	4.12½	5.20	5.85	7.62½	5.42½
August	5.40	5.05	5.35	4.62½	3.10	4.00	3.82½	4.42½	5.16¼	6.05	7.02½	5.35
September	5.15	6.00	5.82½	4.10	2.97½	4.12½	3.77½	4.40	5.27½	6.60	7.50	5.62½
October	5.36¼	6.37½	5.12½	3.85	3.10	3.80	3.62½	4.35	4.92½	6.27½	6.96¼	5.52½
November	5.48¾	5.70	4.32½	3.52½	3.30	3.47½	3.47½	3.95	4.73¾	5.65	6.35	4.67½
December	6.12½	5.12½	4.32½	3.47½	3.25	3.35	3.42½	4.00	4.75	6.00	6.25	4.47½
Yearly average	5.04⅝	6.49	4.99⅜	4.31	3.38½	3.64⅛	3.80¾	3.97¾	5.02¾	5.85⅛	6.78$\frac{7}{16}$	5.90⅝

[a] This table exhibits average cash prices of live hogs for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are averages of the monthly averages.

EGGS.

Wholesale prices of eggs per dozen in leading cities of the United States, 1899–1903.

Date.	New York. Average best fresh.		Cincinnati.		Chicago. Fresh.		St. Louis. Average best fresh.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	17	29	14	22	15	27	13½	22
February	19	35	15	24	16	35	13½	22
March	12½	30	10½	18	11½	26	10	17
April	12½	14½	10½	11½	11	13	10	11½
May	13¼	16	11	12	10¾	13	10¼	11½
June	14½	15½	10	11	11	13¼	10	11
July	15	16½	8½	9½	10	13	9	10
August	15	18	9	11½	10	12½	9	12
September	18	21	11½	15	11	16	11	15½
October	20	22	15	16½	15	17	11	15½
November	21	24	17	17	17	18	16	17
December	21	24	17	17	17	20	17	17
1900.								
January	17	26	15	19	13¾	20	12½	17½
February	13½	19	12½	14	12	16	10½	14
March	12	17	9½	14	10	16	8¾	15½
April	12	13½	9½	11	10¼	11½	8¾	11¼
May	12½	14½	10½	11	10¾	11½	9½	10
June	13	15	10½	11	10	11½	8	10
July	13	17	9	10	10½	11½	7½	9½
August	14	18	9	12	11½	13½	9½	11½
September	12½	14	11½	15	13	16	16	19½
October	19	21	14	16	15½	17½	14	16½
November	20	27	16	20	18	23	16	18½
December	23	29	18	22	20	26	18	23
1901.								
January	19½	27	16	20	17	23	15½	18½
February	17	21½	15	17½	14	19½	14½	17½
March	13	17½	11	15	11½	17	10½	13
April	13½	14	11	12	12	12¾	10½	12
May	13½	14½	11	11	10½	12¼	10	10¾
June	13	14½	11	11	10	12	8½	10
July	14	18	9	10	10	13	6	9
August	16	20	9	13	12½	14½	9	11½
September	18	22	13½	17	13	17	12	16½
October	20	23	17	17	16½	19	16	18
November	22	29	17	23	19	23½	18	22
December	23	31	23	25	23	28	22	25

Wholesale prices of eggs per dozen in leading cities of the United States, etc.—Continued.

Date.	New York. Average best fresh.		Cincinnati.		Chicago. Fresh.		St. Louis. Average best fresh.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1902.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	26	34	22	30	18	28	22	26
February	27	37	21	32	23½	33½	21	32
March	15½	30	13½	23	13¾	26½	13½	26½
April	15½	18	14	15	14	16	13½	15½
May	16	17½	11	15	14½	15½	13½	15
June	17	20	14	14½	14¾	17	13	15½
July	18	20½	14	14½	17	18	11¼	14½
August	18	21	14	16	16	18	13	16
September	20	24	16½	18½	17	20½	15	20
October	21	25	18	21	20	22	17	18½
November	22	26	19	23	21½	24	19½	22½
December	24	29	21	23	20	25	20½	22½
1903.								
January	21	28	20	26	21	26½	17½	22½
February	16	25	12	20	14	20	12½	18
March	14½	21	12	16½	12½	20	11	16½
April	15	17½	12	14	12½	15½	11	14¼
May	16	19	13½	14	13	15	12¼	14
June	17½	19½	13½	14	12½	15½	12½	15
July	18½	23	12	14	11	16	11	12½
August	15½	26	12½	18	10	19	14	19
September	19	28	18	19	16	20	18½	19
October	21	33	19	22	17	23	19	21½
November	22	45	20	28	18	28	21½	26
December	28	45	20	26	22	30	24	28½

TRANSPORTATION RATES.

Average freight rates on grain, in cents, from St. Louis to Liverpool, via river to New Orleans, and via rail to New York.

Year.	To New Orleans by river. On grain in sacks, per 100 pounds.	To New Orleans by river. On wheat in bulk, per bushel.	On wheat to New York by rail, per 100 pounds.	To Liverpool. Via New Orleans on wheat, per bushel.	To Liverpool. Via New York on wheat, per bushel.
1881	20	6	32		
1882	20	6 5/32	29½	22⅔	23⅔
1883	17¾	5¼	33	19 7/12	27
1884	14	6⅝	26	11 7/12	21¼
1885	15	6⅖	22⅐	15⅑	20½
1886	16	6½	29	16⅙	24
1887	18¼	6	32 2/15	15	24⅓
1888	15	6½	29½	15⅙	22.95
1889	17.93	5.95	28½	17⅓	24.97
1890	15.66	6.58	27⅝	14⅓	21.48
1891	16.28	6.87½	29	15¾	23.55
1892	16.87	6.50	26.62	14	21
1893	17.54	6.55	28.50	14.71	21.72
1894	17.14	5.89	24.73	11.69	18.71
1895	13.00	5.95	23.57	12⅛	18.33
1896	14.54	5.00	23.00	13.50	19.67½
1897	10.83	4.88	23.64	12.89	20.33
1898	10.00	4.50	22.25	14.24	20.32
1899	10.00	4.50	21.95	12.33	17.88
1900	10.00	[a] 4.25	19.38	14.61	18.41
1901	10.00	[a] 4.25	19.33	9.48	14.03
1902	10.00	[a] 4.20	20.66	8.53	15.33
1903	10.00	[a] 5.00	22.25	10.00	16.62

[a] F. o. b. New Orleans.

Live stock and dressed meats, Chicago to New York by rail, average rates, in cents, per 100 pounds.

Year.	Cattle.	Hogs.	Sheep.	Horses and mules.	Dressed beef.	Dressed hogs. Refrigerator cars.	Dressed hogs. Common cars.	Year.	Cattle.	Hogs.	Sheep.	Horses and mules.	Dressed beef.	Dressed hogs. Refrigerator cars.	Dressed hogs. Common cars.
1880	55	43	65	60	88	......	......	1892	28	28	30	60	45	45	45
1881	35	31	61	60	56	......	......	1893	28	20	30	60	45	45	45
1882	36	29	53	60	57	......	......	1894	28	30	30	60	45	45	45
1883	40	32	50	60	64	......	......	1895	28	30	30	60	45	45	45
1884	31	28	44	60	51	......	......	1896	28	30	30	60	45	45	45
1885	31	26	43	60	54	......	......	1897	28	30	30	60	45	45	45
1886	33	30	42	60	61	53	48	1898	28	30	30	60	45	45	45
1887	33	32	40	60	62	59	54	1899	a25	25	25	60	40	40	40
1888	22	26	31	60	46	46	44	1900	28	30	30	60	45	45	45
1889	25	30	30	60	47	47	45	1901	28	30	30	60	42.9	42.9	42.9
1890	23	28	30	60	39	39	39	1902	28	30	30	60	41.2	41.2	41.2
1891	27	30	30	60	45	45	45	1903	28	30	30	60	45	45	45

a Rates did not go into effect until February 1, 1899; until that time the 1898 rates governed.

Meats, packed, Cincinnati to New York by rail, average rates, in cents, per 100 pounds.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The year.
1880	39	39	39	34.5	30.5	30.5	30.5	30.5	30.5	30.5	31.5	35	**33.41**
1881	35	35	35	30.5	30.5	25.7	21.5	21.5	21.5	21.5	21.5	21.5	**26.73**
1882	......	21.5	24.3	26	26	26	26	26	26	26	26	30.5	**25.85**
1883	30.5	30.5	30.5	29.2	26	26	26	26	26	26	26.7	30.5	**27.83**
1881	30.5	30.5	23.3	17.5	17.5	18.4	23	26	26	26	26	26	**24.22**
1885	24.4	21.5	20	20.6	18.5	17.5	17.5	21.5	21.5	21.5	22.8	26	**21.10**
1886	26	26	26	26	26	26	26	26	26	26	26	27.7	**26.14**
1887	30.5	30.5	30.5	26	26	26	26	26	26	26	26	26	**27.12**
1888	28	28.5	26.3	26	26	26	19.9	17.3	15.5	18.8	21.5	23.6	**23.11**
1889	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1890	26	26	26	26	26	26	26	24.8	20	20	20	20	**23.89**
1891	20	24.3	26	26	26	26	26	26	26	26	26	26	**25.36**
1892	26	26	26	26	26	25.7	21.5	21.5	21.5	21.5	21.5	21.5	**23.70**
1893	21.5	23.7	26	26	26	26	26	26	26	26	26	26	**25.43**
1894	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1895	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1896	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1897	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1898	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1899	26	26	26	26	26	26	26	26	26	21.5	21.5	21.5	**24.83**
1900	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1901	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1902	26	26	26	26	26	26	26	26	26	26	26	26	**26**
1903	26	26	26	26	26	26	26	26	26	26	26	26	**26**

Compressed cotton by rail, average rates, in cents, per 100 pounds.

Year.	From New Orleans to— a Boston.	From New Orleans to— a New York.	From New Orleans to— a Philadelphia.	From New Orleans to— a Baltimore.	From Memphis to— New York.	From Memphis to— Boston.	Year.	From New Orleans to— a Boston.	From New Orleans to— a New York.	From New Orleans to— a Philadelphia.	From New Orleans to— a Baltimore.	From Memphis to— New York.	From Memphis to— Boston.
1880	60	55	55	55	74	79	1892	55	50	50	50	50.5	55
1881	58	53	54	54	66	71	1893	55	50	50	50	47	52
1882	53	48	51	51	61	66	1894	51	50	50	50	50.5	55.5
1883	60	55	53	52	72	77	1895	53	48	48	48	50.5	55.5
1884	60	55	53	52	54	59	1896	55	50	50	50	50.5	55.5
1885	60	55	53	52	56	58	1897	55	50	50	50	50	55
1886	52	47	45	44	53	58	1898	55	50	50	50	47	52
1887	50	45	43	42	53	58	1899	52	47	47	47	48	53
1888	50	45	43	42	47	52	1900	55	50	50	50	50.5	55.5
1889	52	47	45	44	50.5	55	1901	55	50	50	50	50.5	55.5
1890	55	50	50	50	50.5	55	1902	55	50	50	50	50.5	55.5
1891	55	50	50	50	50.5	55	1903	55	50	50	50	50.5	55.5

a These rates are mainly used for basing purposes.

Corn and wheat, average rates in cents per bushel, Chicago to New York.

Year.	Corn.			Wheat.		
	By lake and canal.[a]	By lake and rail.	By all rail.	By lake and canal.[a]	By lake and rail.	By all rail.
1875	....	11.34	19.5	....	12.09	20.89
1876	8.75	9.68	14.12	9.82	10.19	15.12
1877	9.59	13.42	18.03	11.09	14.75	19.56
1878	8.83	10.45	16.39	9.96	11.99	17.56
1879	10.49	12.2	14.56	11.87	13.13	17.74
1880	13.41	14.43	17.48	13.13	15.8	19.8
1881	7.77	9.42	13.4	8.67	10.49	14.4
1882	6.72	10.28	13.5	7.23	10.91	14.47
1883	8.03	11	15.12	9.01	11.63	16.2
1884	6.55	8.5	12.32	7	10	13.2
1885	6.3	8.01	12.32	6.54	9.02	13.2
1886	8.45	11.2	14	9.10	12	15
1887	8.5	11.2	14.7	9.5	12	15.75
1888	6.71	10.26	13.54	7.05	11.14	14.5
1889	6.32	8.19	12.6	6.92	8.97	15
1890	5.93	7.32	11.36	6.76	8.52	14.3
1891	6.32	7.53	14	6.95	8.57	15
1892	5.95	7.21	12.96	6.45	7.59	13.8
1893	7.18	7.97	13.65	7.66	8.48	14.63
1894	4.93	6.5	12.32	5.11	7	13.2
1895	4.50	6.4	10.29	4.86	6.96	11.89
1896	5.75	6.15	10.5	6.19	6.61	12
1897	4.53	6.92	11.43	5.22	7.42	12.5
1898	3.81	4.41	9.8	[b]4.45	4.91	12
1899	5.08	5.83	10.08	[b]5.81	6.63	11.6
1900	4.07	4.72	9.19	[b]4.49	5.1	9.96
1901	4.61	5.16	9.21	[b]5.11	5.54	9.88
1902	4.83	5.51	9.94	[b]5.26	5.89	10.62
1903	4.85	5.78	10.54	[b]5.4	6.37	11.29

[a] Including Buffalo charges and tolls. [b] Exclusive of Buffalo charges.

Average freight rates, in cents per ton per mile.

Year.	Fitchburg R. R.	Boston and Albany R. R.	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.	Pittsburg, Fort Wayne and Chicago Rwy.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago, Milwaukee and St. Paul Rwy.	Chicago and Alton Rwy.	Union Pacific Rwy.	Louisville and Nashville R. R.	All railways in the United States.
1875	3.624	1.346	1.119	1.061	0.887	0.989	0.970	1.299	1.691	1.688	1.833	1.649	2.164	1.687	1.421
1876	2.218	1.139	.929	.972	.722	.841	.827	1.062	1.587	1.693	1.798	1.438	2.211	1.638	1.217
1877	1.955	1.136	.954	.898	.813	.954	1.024	1.035	1.719	1.563	1.949	1.361	2.135	1.382	1.286
1878	1.582	1.113	.919	.960	.724	.914	.867	.985	1.616	1.539	1.762	1.354	2.236	1.635	1.296
1879	1.299	1.100	.793	.779	.641	.823	.754	.860	1.523	1.429	1.704	1.054	1.991	1.528	1.153
1880	1.36	1.207	.879	.836	.750	.918	......	.866	1.543	1.209	1.749	1.206	......	1.594	1.232
1881	1.26	1.038	.783	.805	.617	.857	.745	.892	1.522	1.220	1.702	1.241	2.178	1.503	1.188
1882	1.17	1.064	.738	.749	.628	.874	.752	.753	1.417	1.281	1.481	1.253	2.102	1.349	1.102
1883	1.19	1.197	.915	.786	.728	.881	.787	.722	1.433	1.170	1.391	1.128	1.913	1.323	1.205
1884	1.09	1.093	.834	.719	.652	.804	.673	.672	1.368	1.097	1.293	1.008	1.557	1.344	1.136
1885	1.06	.944	.688	.656	.553	.695	.577	.550	1.307	1.043	1.278	1.009	1.420	1.159	1.011
1886	1.07	1.101	.765	.659	.639	.755	.692	.541	1.157	1.071	1.168	.961	1.266	1.079	.999
1887	1.13	1.107	.782	.687	.670	.730	.717	.537	1.087	1.012	1.089	.946	1.213	1.075	.984
1888	1.116	1.099	.753	.716	.861	.723	.660	.541	1.068	.964	1.020	.973	1.170	1.049	1.001
1889	1.015	1.030	.712	.644	.632	.685	.69	.538	.839	.971	1.067	.525	1.166	.998	.922
1890	.995	1.105	.730	.665	.644	.661	.69	.561	.942	.995	.995	.898	1.138	.972	.941
1891	.991	1.089	.740	.636	.630	.656	.70	.525	.934	1.039	1.003	.980	1.131	.968	.895
1892	.925	1.057	.699	.614	.602	.647	.67	.518	.908	1.055	1.026	.973	1.080	.918	.898
1893	.923	1.006	.701	.631	.599	.620	.68	.511	.845	1.039	1.026	.949	1.033	.917	.878
1894	.895	.914	.733	.621	.587	.606	.65	.478	.839	.989	1.037	.974	.970	.876	.860
1895	.878	.969	.726	.604	.567	.565	.64	.425	.808	1.084	1.075	.994	.971	.831	.839
1896	.864	.912	.668	.606	.551	.563	.66	.425	.745	1.017	1.003	.925	.957	.806	.806
1897	.870	.918	.679	.610	.538	.561	.60	.419	.671	.958	1.008	.891	.962	.791	.798
1898	.844	.839	.606	.575	.530	.521	.57	.369	.695	.966	.972	.866	.950	.743	.753
1899	.771	.778	.586	.539	.481	.469	.50	.362	.688	.996	.937	.800	1.016	.727	.724
1900	.798	.824	.558	.588	.490	.504	.58	.343	.650	.987	.930	.794	1.050	.752	.729
1901	(a)	.831	.575	.615	.489	.562	.56	.388	.619	1.000	.861	.723	1.042	.772	.750
1902	(a)	(b)	.632	.664	.503	.590	.61	.402	.622	1.034	.810	.678	.979	.744	.757

[a] Leased by the Boston and Maine Railroad.
[b] Leased by the New York Central and Hudson River Railroad.

Average rates, in cents per passenger per mile.

Year.	Fitchburg R. R.	Boston and Albany R. R.	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.	Pittsburg, Fort Wayne and Chicago Rwy.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago, Milwaukee and St. Paul Rwy.	Chicago and Alton Rwy.	Union Pacific Rwy.	Louisville and Nashville R. R.	All railways in the United States.
1875....	1.910	2.180	1.885	1.955	2.088	2.259	2.407	3.231	2.882	2.687	2.690	2.755	2.878	3.219	2.378
1876....	1.864	2.099	1.693	1.859	1.846	1.819	1.830	3.322	2.804	2.626	2.805	2.614	2.974	3.018	2.183
1877....	1.947	2.174	1.953	1.772	2.182	2.185	2.192	3.786	2.912	2.772	2.994	2.798	3.140	3.167	2.458
1878....	1.969	2.217	1.978	2.158	2.255	2.277	2.258	3.738	3.122	2.933	3.029	2.795	3.226	3.345	2.573
1879....	1.888	2.137	2.044	2.090	2.221	2.253	2.228	3.630	3.066	2.971	2.908	2.417	......	3.444	2.484
1880....	1.885	2.096	1.999	2.041	2.135	2.222	2.156	2.959	2.514	2.806	2.868	2.076	......	3.476	2.442
1881....	1.820	1.970	1.862	2.016	1.988	2.152	1.895	2.989	2.164	2.666	2.856	1.828	3.311	3.168	2.446
1882....	1.715	1.993	1.808	1.948	2.156	2.249	2.024	2.605	2.388	2.505	2.579	1.951	3.300	2.706	2.391
1883....	1.790	2.088	1.986	1.673	2.196	2.297	2.193	2.373	2.424	2.504	2.516	2.141	3.128	2.614	2.402
1884....	1.651	1.908	1.942	2.189	2.170	2.258	2.222	2.379	2.225	2.572	2.553	1.900	2.952	2.342	3.323
1885....	1.833	1.838	1.419	1.756	2.058	1.950	1.569	2.270	2.211	2.466	2.563	2.026	2.749	2.103	2.216
1886....	1.756	1.853	1.845	1.890	2.098	2.114	2.130	2.131	2.208	2.420	2.415	2.023	2.135	2.436	2.142
1887....	1.89	1.880	1.989	2.039	2.260	2.125	2.255	2.074	2.268	2.328	2.538	2.062	2.301	2.394	2.245
1888....	1.978	1.976	1.967	1.851	2.280	2.111	2.10	2.025	2.197	2.312	2.415	2.123	2.248	2.429	2.349
1889....	1.957	1.869	1.932	1.722	2.286	2.076	2.18	1.709	1.927	2.285	2.415	2.128	2.135	2.370	2.165
1890....	1.915	1.858	1.910	1.584	2.254	2.094	2.25	2.056	2.022	2.149	2.359	2.004	2.045	2.403	2.167
1891....	1.869	1.818	1.905	1.601	2.105	2.070	2.23	2.155	2.073	2.322	2.408	2.205	2.059	2.483	2.142
1892....	1.916	1.828	1.887	1.589	2.183	2.028	2.00	2.181	2.101	2.308	2.464	2.043	2.104	2.448	2.126
1893....	1.869	1.835	1.832	1.551	2.195	1.968	1.98	1.989	1.999	2.095	2.414	1.981	1.987	2.432	2.108
1894....	1.851	1.794	1.857	1.509	2.069	1.993	2.00	1.905	1.925	1.891	2.191	1.776	1.758	2.365	1.986
1895....	1.819	1.770	1.837	1.560	2.215	1.971	2.06	1.980	1.995	2.146	2.411	2.119	1.962	2.318	2.040
1896....	1.769	1.752	1.838	1.641	2.148	1.950	1.88	1.952	1.979	2.108	2.375	2.117	2.075	2.187	2.019
1897....	1.811	1.754	1.812	1.543	2.108	1.958	2.02	1.980	1.979	2.153	2.289	2.116	2.101	2.254	2.022
1898....	1.826	1.750	1.806	1.548	2.032	a1.953	2.02	1.943	1.938	2.092	2.362	2.058	1.945	2.152	1.973
1899....	1.800	1.744	1.766	1.536	2.074	a1.937	2.02	1.860	2.014	2.036	2.337	2.055	1.941	2.243	1.925
1900....	1.805	1.754	1.793	1.540	2.223	1.952	2.05	1.973	2.021	2.061	2.346	1.908	1.968	2.318	2.003
1901....	(b)	1.742	1.799	1.541	1.993	1.992	2.09	1.984	1.960	2.095	2.324	1.936	2.085	2.355	2.013
1902....	(b)	(c)	1.723	1.531	1.828	1.999	2.04	2.023	1.999	2.135	2.317	1.860	2.007	2.319	1.986

a Excludes ferry earnings at Jersey City, N. J.
b Leased by the Boston and Maine Railroad.
c Leased by the New York Central and Hudson River Railroad.

Average rates on grain, flour, and provisions, in cents per 100 pounds, through from Chicago to European ports, by all rail to seaboard and thence by steamers, from 1894 to 1903.

Shipped to—	Articles.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Liverpool.....	Grain..........	32.5	32	33.5	33.6	34.35	29.72	29.48	21.47	20.85	22.68
Do........	Sacked flour..	33.16	34	31.3	36.81	37.66	30.12	27.9	23	23.5	25.19
Do........	Provisions....	44.06	41.81	44.91	44.4	47.15	40.5	48.84	36	36.25	41.9
Glasgow	Grain..........	34.63	34.19	34.22	35.23	36	32.35	30.98	24.1	21.75	24.43
Do........	Sacked flour..	35.03	36.25	36.5	39.06	39.06	31.25	31.56	24.38	22.75	25.38
Do........	Provisions....	46.59	49.69	49.97	52.5	52.5	44.69	55.31	45.16	41.88	46.88
London	Grain..........	32.88	33.29	33.48	34	35	30.6	31.1	23.23	21.75	23.56
Do........	Sacked flour..	34.93	35.13	35.28	36.12	37.25	33.5	35.01	25.5	24	25.19
Do........	Provisions....	45.75	46.03	47.15	48.14	49.69	44.14	55.87	44.75	39.06	44.06
Antwerp	.....do........	46.88	48.28	49.69	51.09	52.5	47.5	51.09	46.25	41.5	49.69
Hamburg.....	.....do........	50	50	51	51	52	46	50	44	39	47
Amsterdam...	.....do........	50	50	52	52	52.5	47	51	45	40	42
Rotterdam ...	.....do........	50	48	52	52	52.5	47	51	45	40	42
Copenhagen..	.....do........	55.31	55.31	58.12	57.28	58.13	51.72	55.31	47.75	42	49.69
Stockholm....	.....do........	66.56	66.56	69.37	68.53	69.25	62.97	61.5	53.25	45	52.5
Stettin........	.....do........	55.31	55.31	58.12	57.28	58.13	51.72	55.31	47.75	42	49.69
Bordeaux.....	.....do........	62.5	64.13	64.13	64.13	65.75	59.12	64.12	54.25	51.25	56.25

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS.[a]

[From Bureau of Statistics, Department of Commerce and Labor.]

Agricultural imports of the United States during the five years ending June 30, 1903.

Articles imported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle—										
For breeding purposes, number	624	$95,353	1,045	$202,615	1,249	$273,728	1,928	$375,096	1,481	$225,875
Other ....number	199,128	2,225,009	179,961	2,055,079	144,773	1,657,705	94,099	1,233,626	64,694	935,673
Total cattle ....do	199,752	2,320,362	181,006	2,257,694	146,022	1,931,433	96,027	1,608,722	66,175	1,161,548
Horses—										
For breeding purposes, number	1,067	296,252	1,284	357,272	1,910	714,623	2,944	1,273,607	2,803	1,191,611
Other ....number	1,975	254,798	1,818	239,320	1,875	271,115	1,888	303,627	2,196	344,685
Total horses ....do	3,042	551,050	3,102	596,592	3,785	985,738	4,832	1,577,234	4,999	1,536,296
Sheep—										
For breeding purposes, number	2,396	46,132	2,427	48,324	2,032	48,989	2,059	46,663	1,737	38,037
Other ....number	343,515	1,153,949	379,365	1,316,702	329,456	1,187,288	264,894	910,047	299,886	998,897
Total sheep ....do	345,911	1,200,081	381,792	1,365,026	331,488	1,236,277	266,953	956,710	301,623	1,036,934
All other, including fowls	....	265,032	....	311,638	....	325,507	....	481,865	....	799,067
Total live animals	....	4,336,525	....	4,530,950	....	4,478,955	....	4,624,531	....	4,533,845
Beeswax ....pounds	452,016	109,957	213,813	51,526	213,773	55,884	408,706	115,937	488,576	127,220
Bladders, other than fish	....	(b)	....	(b)	....	(b)	....	(b)	....	34,019
Bones, hoofs, and horns	....	704,959	....	830,063	....	674,368	....	692,634	....	619,239
Bristles:										
Crude, unsorted ......pounds	21,421	12,399	27,140	22,330	51,539	22,310	40,537	28,446	34,239	13,069
Sorted, bunched, or prepared, pounds	1,835,156	1,445,853	2,503,018	2,130,537	1,633,036	1,707,887	1,972,572	2,018,885	3,009,806	2,641,535
Total ....pounds	1,856,577	1,458,252	2,530,158	2,152,867	1,684,575	1,730,197	2,013,109	2,047,331	3,044,045	2,654,604

Cochineal c ....pounds..	97,563	23,207	157,917	31,211	114,414	20,414	138,821	24,865	112,714	24,215
Dairy products:										
Butter..................do....	23,700	3,962	49,791	9,769	93,669	19,441	453,978	80,725	207,007	51,564
Cheese ....do....	11,826,175	1,563,128	13,455,990	1,761,613	15,329,099	2,120,293	17,067,714	2,551,366	20,671,384	3,183,224
Milk	....	52,603	....	42,686	....	48,062	....	33,457	....	42,696
Total.........................	....	1,619,693	....	1,814,068	....	2,187,796	....	2,665,548	....	3,277,484
Eggs ....dozens..	225,180	21,300	135,038	8,741	126,520	10,515	384,070	37,432	368,482	29,757
Egg yolks	....	11,322	....	19,594	....	246	....	6,869	....	25,795
Feathers and downs, crude	....	1,768,092	....	1,736,458	....	1,524,859	....	2,032,566	....	2,476,659
Fibers, animal:										
Silk—										
Cocoons ....pounds..	13,537	2,288	30,004	18,235	132	139	4,118	1,695	259	158
Raw, or as reeled from the cocoon, pounds..........	9,691,145	31,827,061	11,259,310	44,549,672	9,139,617	29,353,777	12,620,682	41,714,331	13,637,206	49,002,597
Waste ....pounds..	1,545,701	650,278	1,784,404	761,853	1,265,806	697,449	1,610,026	919,325	1,633,394	1,008,295
Total silk..........do....	11,250,383	32,479,627	13,073,718	45,329,760	10,405,555	30,051,365	14,234,826	42,635,351	15,270,859	50,011,050
Wool and hair of the camel, goat, alpaca, and like animals—										
Class 1, clothing..pounds..	12,976,999	1,948,954	37,404,243	8,009,985	30,681,475	5,025,194	66,131,670	7,927,919	42,202,121	7,488,394
Class 2, combing ....do....	2,155,419	587,061	12,631,283	2,633,721	5,484,264	1,074,701	6,091,024	1,071,866	15,233,113	2,833,435
Class 3, carpet.......do....	61,603,791	5,786,882	105,892,929	9,617,230	67,417,766	6,429,986	91,354,272	8,712,003	119,702,562	11,831,132
Total wool ....do....	76,736,209	8,322,897	155,928,455	20,260,936	103,583,505	12,529,881	166,576,966	17,711,788	177,137,796	22,152,961
Total animal fibers.do....	87,986,592	40,802,524	169,002,173	65,590,696	113,989,060	42,581,246	180,811,792	60,347,139	192,408,655	72,164,011
Gelatin manufactures	....	21,961	....	30,361	....	23,230	....	(d)	....	(d)
Glue....................pounds..	5,358,063	479,450	5,577,082	537,492	4,540,951	473,341	4,787,762	477,036	5,560,616	602,077
Grease. (*See* Meat and meat products.)										
Gut	....	15,905	....	13,138	....	1,826	....	15,826	....	101,827
Hair	....	1,814,964	....	2,445,964	....	1,611,424	....	1,980,319	....	2,702,734
Hide cuttings and other glue stock.	....	708,968	....	1,223,521	....	1,057,931	....	696,439	....	834,421
Hides and skins, other than furs:										
Cattle hides ....pounds..	130,396,020	13,621,946	163,865,165	19,408,217	129,174,624	14,647,413	148,627,907	17,474,039	131,640,325	16,159,902
Goatskins ....do....	69,728,945	18,488,326	81,998,818	21,987,674	73,745,596	20,577,033	88,038,516	25,478,179	85,114,070	24,928,729
Other...................do....	66,965,785	9,877,771	100,070,795	16,539,807	77,989,617	12,995,567	89,457,680	15,054,400	102,340,303	16,942,982
Total ....do....	267,090,750	41,988,043	345,934,778	57,935,698	280,909,837	48,220,013	326,124,103	58,006,618	319,094,698	58,031,613

a Forest products come within the scope of the Department of Agriculture, and therefore are included in alphabetical order in the following tables.
b Not stated.
c Classed as agricultural for the first time in 1902; the statistics for earlier years are not included in the total imports of agricultural products for 1899-1901.
d No longer classed as agricultural.

Agricultural imports of the United States during the five years ending June 30, 1903—Continued.

Articles imported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Honey ....gallons..	126,217	$51,599	146,860	$70,857	182,196	$83,599	167,301	$56,383	287,696	$115,400
Meat and meat products:										
Meat—										
Sausages, bologna....	....	93,714	....	95,944	....	80,605	....	109,791	....	111,647
Other, including meat extracts	....	263,845	....	365,589	....	407,003	....	464,745	....	719,250
Total meat....	....	357,559	....	461,533	....	487,608	....	574,536	....	830,897
Meat products										
Grease	....	696,674	....	779,666	....	756,453	....	981,494	....	876,246
Oils....gallons..	9,056	1,569	18,050	3,255	59,131	12,858	161,306	29,060	261,421	50,641
Rennets....	....	93,284	....	66,907	....	88,744	....	93,358	....	76,785
Sausage casings....	....	622,949	....	646,889	....	642,212	....	754,588	....	963,495
Stearin ....pounds..	1,865,977	25,546	1,524,722	27,895	3,684,720	67,686	7,634,293	492,287	10,481,807	1,097,450
Other	....	114,843	....	106,163	....	54,667	....	380,403	....	706,802
Total meat products	....	1,554,865	....	1,630,775	....	1,622,620	....	2,731,190	....	3,771,419
Total meat and meat products	....	1,912,424	....	2,092,308	....	2,110,228	....	3,305,726	....	4,602,316
Oils, animal. (*See* Meat and meat products.)										
Rennets. (*See* Meat and meat products.)										
Stearin. (*See* Meat and meat products.)										
Total animal matter	....	97,825,938	....	141,084,302	....	106,825,658	....	137,133,199	....	152,957,236
VEGETABLE MATTER.										
Argols, or wine lees ....pounds..	23,300,762	1,914,450	27,339,489	2,388,693	28,598,781	2,476,482	29,276,148	2,263,588	29,966,557	2,734,027
Breadstuffs. (*See* Grain and grain products.)										
Broom corn ....tons..	(*a*)	(*a*)	549	49,612	6	618	5	553	3	288
Cider ....gallons..	(*a*)	(*a*)	2,647	2,287	4,376	3,496	8,006	7,159	4,871	4,751

Cocoa and chocolate:										
Cocoa—										
Crude, and leaves and shells of ......pounds..	35,512,364	5,064,703	41,746,872	5,657,283	45,924,353	6,472,829	51,379,396	6,656,504	63,351,294	7,820,087
Prepared, or manufactured ....pounds..	926,219	295,413	1,012,368	313,561	977,003	288,840	973,970	295,921	1,004,766	292,522
Total cocoa......do....	36,438,583	5,360,116	42,759,240	5,970,844	46,901,356	6,761,669	52,353,366	6,952,425	64,356,060	8,112,609
Chocolate ....do....	1,124,515	201,439	1,209,012	240,141	718,848	141,892	525,221	101,536	690,824	144,832
Total cocoa and chocolate, pounds....................	37,563,098	5,561,555	43,968,252	6,210,985	47,620,204	6,903,561	52,878,587	7,053,961	65,046,884	8,257,411
Coffee ....pounds..	831,827,063	55,275,470	787,991,911	52,467,943	854,871,310	62,861,399	1,091,004,252	70,982,155	915,086,380	59,200,746
Coffee substitutes:										
Chicory root—										
Raw, unground .....do....	159,269	2,353	1,216,518	17,762	511,693	9,833	238,272	4,687	1,411,202	27,967
Roasted, ground, or otherwise prepared ..pounds..	335,347	11,061	384,957	12,941	348,597	11,098	298,671	10,451	442,311	17,493
Total chicory root, pounds..............	494,616	13,414	1,601,475	30,703	860,290	20,931	536,943	15,138	1,853,513	45,460
Other................pounds..	992,395	36,370	1,262,659	49,029	875,420	38,354	400,527	20,499	450,643	23,613
Total coffee substitutes, pounds....................	1,487,011	49,784	2,864,134	79,732	1,735,710	59,285	937,470	35,637	2,304,156	69,073
Curry and curry powder..........	....	7,383	....	8,770	....	7,497	....	9,010	....	9,112
Fibers, vegetable:										
Cotton...............pounds..	50,158,158	5,013,146	67,398,521	7,960,945	46,631,283	6,787,828	98,715,680	11,712,170	74,874,426	10,892,591
Flax...................tons..	6,474	1,306,520	6,967	1,646,274	6,878	1,880,717	7,772	2,094,915	8,155	2,028,012
Hemp ....do....	3,941	477,108	3,400	450,269	4,057	622,814	6,054	1,013,911	4,919	821,261
Istle, or Tampico fiber...do....	4,419	284,177	5,748	475,090	2,334	163,566	7,819	495,254	14,670	1,086,682
Jute and jute butts......do....	83,161	2,296,189	102,693	3,956,413	103,140	4,412,482	128,963	4,447,987	79,703	3,358,825
Manila hemp...........do....	53,195	6,211,475	42,624	7,172,368	43,735	7,115,446	56,453	10,555,272	61,648	11,885,510
Sisal grass ....do....	71,898	9,211,377	76,921	11,782,263	70,076	7,972,564	89,583	11,961,213	87,025	13,289,414
Other....................do....	7,466	513,247	10,953	891,128	8,013	764,917	9,083	977,410	16,075	1,992,779
Total..........................	....	25,313,239	....	34,334,750	....	29,720,334	....	43,258,132	....	45,355,104
Flowers, natural..................	....	19,392	....	30,621	....	21,268	....	30,382	....	31,577
Forest products:										
Cinchona bark ....pounds..	3,281,977	346,576	4,107,358	563,065	4,858,904	1,025,546	3,723,303	649,764	3,978,850	519,753
Cork wood or cork bark	....	1,147,802	....	1,444,825	....	1,729,912	....	1,816,107	....	1,737,366

a Not stated.

Agricultural imports of the United States during the five years ending June 30, 1903—Continued.

Articles imported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Forest products—Continued.										
Dyewoods, and extracts of—										
Dyewoods—										
Logwood ....tons..	37,375	$546,274	48,188	$628,464	54,793	$864,986	52,657	$774,380	51,008	$748,550
Other	....	222,967	....	233,998	....	213,812	....	171,120	....	401,849
Total dyewoods......	....	769,241	....	862,462	....	1,078,798	....	945,500	....	1,150,399
Extracts and decoctions of, pounds..................	3,183,864	219,192	3,350,768	221,182	2,922,141	195,647	2,991,631	213,404	3,723,133	267,371
Total dyewoods and extracts of	....	988,433	....	1,083,644	....	1,274,445	....	1,158,904	....	1,417,770
Gums, not elsewhere specified—										
Arabic................pounds..	928,089	116,382	961,366	113,041	2,315,679	241,660	4,269,251	341,714	3,905,053	265,386
Camphor, crude.........do....	1,807,889	322,100	1,789,580	485,071	2,175,784	738,875	1,831,058	576,405	2,472,440	764,403
Chicle...................do....	2,445,061	363,051	2,297,992	354,720	3,140,768	753,696	4,574,605	936,065	4,282,247	954,389
Copal, cowrie, and dammar, pounds.....................	18,126,228	1,844,779	23,829,342	2,598,194	18,166,296	1,923,251	20,523,109	2,261,206	27,653,928	2,938,754
Gambier, or terra japonica, pounds.....................	38,123,478	754,497	38,882,940	910,639	26,813,587	824,539	28,453,802	1,162,233	42,537,348	2,034,511
Shellac...............pounds..	9,830,111	1,397,635	10,621,451	1,408,103	9,608,745	1,277,128	9,064,789	1,605,068	11,590,725	2,713,687
Other	....	1,070,321	....	1,014,936	....	879,990	....	861,492	....	923,517
Total.........................	....	5,868,765	....	6,884,704	....	6,639,139	....	7,744,183	....	10,594,647
Hemlock bark.............cords..	17,845	62,504	22,580	86,630	16,794	65,418	24,971	103,930	17,040	75,283
India rubber, gutta-percha, etc.:										
Gutta-joolatong, or East Indian gum..........pounds..	6,473,882	166,419	8,701,753	237,214	9,371,087	248,838	16,850,821	501,418	13,981,817	345,431
Gutta-percha............do....	518,939	167,577	427,678	178,616	280,560	130,957	525,767	252,329	316,290	222,400
India rubber ....do....	51,063,066	31,707,630	49,377,138	31,376,867	55,275,529	28,455,383	50,413,481	24,899,230	55,010,571	30,436,710
Total ....do....	58,055,887	32 041,626	58,506,569	31,792,697	64,927,176	28,835,178	67,790,069	25,652,977	69,311,678	31,004,541
Ivory, vegetable............do....	8,864,257	88,479	16,073,505	243,548	13,461,461	179,735	14,699,215	165,489	17,194,434	192,093

Naval stores:										
Tar and pitch (of wood), barrels	1,580	8,684	2,829	13,922	2,107	11,520	1,660	8,796	1,242	6,004
Turpentine, spirits of..gallons	...	(a)	22,183	7,547	13,630	4,441	8,457	2,814	16,705	6,020
Total	...	...	...	21,469	...	15,961	...	11,610	...	12,024
Palm leaf, natural	...	10,483	...	15,128	...	7,085	...	10,905	...	5,339
Sumac, ground..........pounds	12,975,970	183,136	10,335,980	228,177	7,339,606	133,303	9,182,917	145,776	12,858,547	187,186
Tanning materials, n. e. s	...	13,099	...	26,219	...	46,477	...	47,500	...	56,401
Wood, not elsewhere specified:										
Cabinet woods, unsawed—										
Mahogany.........M feet	24,714	1,244,921	28,228	1,572,269	32,281	1,752,612	41,795	2,361,483	48,387	2,783,679
Other	...	846,356	...	858,433	...	1,240,737	...	999,792	...	1,251,621
Total cabinet woods	...	2,091,277	...	2,430,702	...	2,993,349	...	3,361,275	...	4,035,300
Timber—										
Round, including logs, M feet	198,195	1,766,294	101,397	879,956	82,985	804,188	106,171	907,168	73,836	637,881
Hewn, squared, or sided, cubic feet	133,792	18,068	564,789	46,550	112,653	18,810	129,183	18,027	207,554	41,131
Total timber	...	1,784,362	...	926,506	...	822,998	...	925,195	...	679,012
Lumber—										
Boards, deals, planks, and other sawed lumber, M feet	423,928	4,200,168	680,226	7,475,509	490,820	6,361,423	665,603	9,271,090	720,937	10,673,317
Shingles..........M feet	471,594	827,886	541,040	1,011,234	555,853	1,028,184	707,614	1,362,821	724,131	1,494,906
Other	...	987,139	...	1,342,593	...	1,246,509	...	1,380,973	...	1,753,532
Total lumber	...	6,015,193	...	9,829,336	...	8,636,116	...	12,014,884	...	13,921,755
All other	...	1,992,341	...	2,650,798	...	3,152,586	...	3,319,458	...	3,621,782
Total wood, n. e. s	...	11,883,173	...	15,837,342	...	15,605,049	...	19,620,812	...	22,257,849
Wood pulp..........tons	33,319	671,506	82,441	2,405,630	46,757	1,586,402	67,416	2,059,092	116,881	3,387,770
Total forest products	...	53,314,266	...	60,633,078	...	57,143,650	...	59,187,049	...	71,478,022
Fruit juices, n. e. s.:										
Prune juice, or prune wine, gallons	35,047	27,204	40,761	33,215	37,686	26,885	42,817	32,925	53,135	40,435
Other, including cherry juice, gallons	44,841	23,173	48,727	30,087	42,152	20,989	29,108	15,114	32,810	16,709
Total..........gallons	79,888	50,377	89,488	63,302	79,838	47,874	71,925	48,039	85,945	57,144

a Not stated.

Agricultural imports of the United States during the five years ending June 30, 1903—Continued.

Articles imported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Fruits and nuts:										
Fruits—										
Fresh or dried—										
Bananas	....	$5,665,588	....	$5,877,835	....	$6,550,186	....	$7,307,437	....	$8,541,156
Currants......pounds..	30,849,253	798,357	36,251,779	916,908	16,049,198	916,994	36,238,976	1,238,756	33,878,209	743,644
Dates............do...	12,913,305	324,087	19,902,512	410,349	18,434,917	372,400	20,013,681	344,833	21,681,159	486,151
Figs.............do...	7,284,058	356,762	8,812,487	513,895	9,933,871	458,513	11,087,131	487,733	16,482,142	775,917
Lemons...........do...	225,942,718	4,398,004	160,198,056	3,666,881	148,514,614	3,516,856	164,075,309	3,320,359	152,004,213	3,079,221
Oranges..........do...	83,497,669	1,097,596	68,618,938	1,087,041	50,332,914	716,457	52,742,476	784,640	56,872,070	818,780
Plums and prunes, pounds	600,360	63,574	443,457	47,700	745,974	62,880	522,478	44,077	633,819	63,218
Raisins.......pounds..	4,933,201	282,400	10,309,498	531,124	3,860,836	297,631	6,683,545	399,973	6,715,675	476,844
Other	....	1,579,652	....	1,989,546	....	2,059,130	....	2,053,588	....	2,353,864
Total fresh or dried..	....	14,566,020	....	15,041,279	....	14,951,047	....	15,981,396	....	17,338,795
Prepared or preserved	....	1,020,644	....	1,243,479	....	1,366,801	....	1,454,788	....	1,521,443
Total fruits	....	15,586,664	....	16,284,758	....	16,317,848	....	17,436,184	....	18,860,238
Nuts—										
Almonds.........pounds..	9,957,427	1,222,587	6,317,633	949,083	5,140,232	946,138	9,868,982	1,240,886	8,142,164	1,337,717
Cocoanuts	....	625,789	....	702,947	....	804,233	....	832,383	....	908,242
Walnuts.........pounds..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	12,362,567	1,106,033
Other	....	879,166	....	1,326,804	....	1,518,484	....	1,971,072	....	1,514,406
Total nuts	....	2,727,542	....	2,978,834	....	3,268,855	....	4,044,341	....	4,866,398
Total fruits and nuts	....	18,314,206	....	19,263,592	....	19,586,703	....	21,480,525	....	23,726,636
Ginger, preserved or pickled, pounds	142,698	6,309	429,198	17,917	340,690	17,306	660,494	28,194	569,292	23,810
Grain and grain products:										
Grain—										
Barley...........bushels..	110,475	53,696	189,757	91,040	171,004	84,073	57,406	33,221	56,462	30,201
Corn (maize)........do...	4,171	1,618	2,480	1,942	5,169	3,418	18,278	13,418	40,919	29,966
Oats.................do...	11,500	4,432	41,523	18,360	20,735	8,995	25,812	12,085	137,416	45,899
Rye..................do...	402	982	330	366	46	33	88	97	838	430
Wheat................do...	1,871,101	1,407,625	316,968	240,496	600,212	418,327	118,612	78,640	1,077,424	669,419
Total grain.......do...	1,997,649	1,468,353	551,058	352,204	797,166	514,846	220,196	137,461	1,313,059	775,915

Grain products—										
Meal and flour—										
Oatmeal......pounds..	298,764	17,740	234,959	13,499	204,694	11,667	236,981	13,628	227,681	13,685
Wheat flour...barrels..	905	4,057	717	3,771	642	3,430	420	2,610	601	4,489
Total meal and flour..	....	21,797	....	17,270	....	15,097	....	16,238	....	18,174
Malt, barley......bushels..	4,984	4,447	4,399	4,127	4,580	4,635	3,019	2,929	2,468	3,029
Macaroni, vermicelli, etc., pounds..................	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	28,787,821	1,171,887
Other	....	851,000	....	1,023,226	....	1,078,995	....	1,380,658	....	438,963
Total grain products....	....	877,244	....	1,044,623	....	1,098,727	....	1,399,825	....	1,632,053
Total grain and grain products..............	....	2,345,597	....	1,396,827	....	1,613,573	....	1,537,286	....	2,407,968
Hay ....tons..	19,872	115,409	143,890	1,019,743	142,620	1,128,610	48,415	381,417	293,112	2,238,109
Hops ....pounds..	1,319,319	591,755	2,589,725	713,701	2,606,708	851,008	2,805,293	833,702	6,012,510	1,808,491
Indigo.........................do....	3,127,357	1,698,583	2,746,944	1,446,490	3,139,063	1,402,894	3,057,673	1,035,980	4,532,458	1,202,451
Licorice root *b*..............do....	98,432,319	1,566,830	106,333,199	1,667,256	100,105,654	1,737,097	109,077,323	1,926,903	88,580,611	1,545,167
Liquors, alcoholic:										
Distilled spirits—										
Of domestic manufacture, returned..proof gallons..	998,173	834,948	687,024	630,574	875,099	794,594	805,212	749,687	819,591	846,404
Brandy...............do....	219,968	626,875	244,100	696,540	290,301	843,318	316,222	911,419	348,878	1,000,997
Other................do....	1,227,834	1,683,256	1,550,896	2,282,717	1,712,156	2,524,237	1,909,887	2,784,048	2,061,057	2,987,179
Total distilled spirits, proof gallons...........	2,445,975	3,145,079	2,482,020	3,609,831	2,877,556	4,162,149	3,031,321	4,445,154	3,229,526	4,834,580
Malt liquors—										
Unbottled ....gallons..	1,928,672	570,692	2,228,502	647,533	2,447,555	719,092	2,553,105	718,383	2,966,313	835,694
Bottled..............do....	918,562	917,186	1,081,818	1,079,723	1,151,891	1,166,123	1,198,406	1,161,965	1,292,475	1,252,047
Total malt liquors .do....	2,847,234	1,487,878	3,310,320	1,727,256	3,599,446	1,885,215	3,751,511	1,880,348	4,258,818	2,087,741
Wines—										
Champagne and other sparkling, dozen quarts..	262,371	3,668,791	310,149	4,115,908	311,078	4,589,494	335,256	4,930,768	407,944	5,861,639
Still wines—										
Unbottled ....gallons..	2,253,226	1,573,573	2,533,828	1,744,736	2,785,850	1,942,322	3,300,026	2,143,433	3,753,211	2,292,297
Bottled, dozen quarts..	274,873	1,347,842	315,920	1,560,851	373,832	1,687,420	397,818	1,846,937	410,869	2,095,360
Total still wines	....	2,921,415	....	3,305,587	....	3,629,742	....	3,990,370	....	4,387,657
Total wines	....	6,590,206	....	7,421,495	....	8,219,236	....	8,921,138	....	10,249,296
Total alcoholic liquors................	....	11,223,163	....	12,758,582	....	14,266,600	....	15,246,640	....	17,171,617

a Not stated. *b* Classed as a farm product for the first time in 1902; the statistics for earlier years are not included in the total imports of farm products for 1899–1901.

Agricultural imports of the United States during the five years ending June 30, 1903—Continued.

Articles imported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Malt, barley. (*See* Grain and grain products.)										
Malt extract, fluid or solid	....	$5,320	....	$4,320	....	$4,863	....	$3,683	....	$3,008
Malt liquors. (*See* Liquors, alcoholic.)										
Nursery stock:										
Plants, trees, shrubs, vines, etc	....	....	....	....	....	....	....	1,172,023	....	1,371,588
Subtropical plants, etc., for propagation	....	....	....	....	....	....	....	547	....	1,610
Total nursery stock	....	768,982	....	972,385	....	1,098,932	....	1,172,570	....	1,373,198
Oil cake ....pounds	1,885,648	9,553	208,657	1,437	448	64	2,614,059	20,740	3,827 014	30,286
Oil cake (substitute for india rubber)	....	1,149	....	846	....	(*a*)	....	(*a*)	....	(*a*)
Oils, vegetable:										
Fixed or expressed—										
Olive, salad ......gallons	930,042	1,090,250	967,702	1,170,871	983,059	1,266,293	1,339,097	1,579,409	1,494,132	1,736,648
Other	....	2,519,157	....	3,290,656	....	3,422,170	....	5,046,811	....	7,750,712
Total fixed or expressed	....	3,609,407	....	4,461,527	....	4,688,463	....	6,626,220	....	9,487,360
Volatile, or essential	....	1,691,257	....	1,859,184	....	1,959,395	....	2,092,371	....	2,156,331
Total vegetable oils	....	5,300,664	....	6,320,711	....	6,647,858	....	8,718,591	....	11,643,691
Opium, crude ....pounds	513,499	1,223,951	544,938	1,128,756	583,208	1,259,726	534,189	1,216,202	516,570	1,019,909
Opium, prepared ....do	124,214	828,203	142,479	1,065,965	117,581	972,582	(*b*)	(*b*)	(*b*)	(*b*)
Rice, rice meal, etc.:										
Rice ....do	153,837,026	3,152,771	93,648,451	1,904,915	74,598,061	1,588,044	75,674,776	1,596,210	78,317,310	1,732,238
Rice flour, rice meal, and broken rice ......pounds	50,340,267	777,378	23,031,440	374,121	42,601,649	736,854	81,984,118	1,330,711	91,338,974	1,329,235
Total ....do	204,177,293	3,930,149	116,679,891	2,279,036	117,199,710	2,324,898	157,658,894	2,926,921	169,656,284	3,061,173
Sago, tapioca, etc	....	203,615	....	411,029	....	443,333	....	545,938	....	618,221

Seeds:										
Flaxseed, or linseed..bushels..	81,953	87,602	67,379	94,126	1,631,726	2,098,207	477,157	724,082	129,089	194,024
Other	....	1,134,243	....	1,700,922	....	1,940,987	....	2,528,070	....	2,637,255
Total	....	1,221,845	....	1,795,048	....	4,039,194	....	3,252,152	....	2,831,279
Spices:										
Unground—										
Nutmegs ....pounds..	1,530,102	368,765	1,590,811	351,383	1,836,417	360,889	1,841,614	339,685	2,365,624	444,643
Pepper, black or white, pounds	12,332,747	1,083,100	13,085,333	1,283,635	16,081,849	1,806,167	16,046,179	1,752,345	21,832,675	2,296,221
Other............pounds..	13,851,055	997,783	19,652,762	1,376,243	13,506,848	1,001,482	15,134,481	1,146,246	22,464,192	1,590,778
Total unground ...do....	27,713,904	2,449,648	34,328,906	3,011,261	31,425,114	3,168,538	33,022,274	3,238,276	46,662,491	4,331,642
Ground..................do....	3,346,925	332,653	4,516,709	390,004	3,786,623	394,571	4,460,841	446,966	4,538,688	483,483
Total spices ....do....	31,060,829	2,782,301	38,845,615	3,401,265	35,211,737	3,563,109	37,483,115	3,685,242	51,201,179	4,815,125
Spirits, distilled. (*See* Liquors, alcoholic.)										
Starch..................pounds..	8,542,897	140,528	11,767,924	222,296	7,302,501	179,340	11,714,931	235,645	10,540,905	205,949
Straw......................tons..	2,075	4,564	5,495	15,750	9,633	35,816	2,986	11,723	3,303	12,832
Sugar and molasses:										
Molasses.............gallons..	5,821,556	789,576	7,025,068	890,524	11,453,156	1,123,923	14,391,215	1,037,696	17,240,399	1,124,710
Sugar—										
Raw—										
Beet..........pounds..	723,336,352	15,269,397	701,539,452	14,800,609	908,683,078	20,028,575	255,030,219	4,202,044	87,130,805	1,223,023
Cane ....do....	3,194,168,454	78,001,772	3,305,087,796	85,059,367	2,956,586,102	67,507,439	2,685,792,937	48,684,775	4,075,635,121	69,740,051
Total raw......do....	3,917,504,806	93,271,169	4,006,627,248	99,859,976	3,865,269,180	87,536,014	2,940,823,156	52,886,819	4,162,765,926	70,963,074
Refined.............do....	62,745,763	1,692,951	11,459,282	390,998	109,736,660	2,951,786	91,092,719	2,174,278	53,342,180	1,125,899
Total sugar........do....	3,980,250,569	94,964,120	4,018,086,530	100,250,974	3,975,005,840	90,487,800	3,031,915,875	55,061,097	4,216,108,106	72,088,973
Total sugar and molasses	....	95,753,696	....	101,141,498	....	91,611,723	....	56,098,793	....	73,213,683
Tea......................pounds..	74,089,899	9,675,081	84,845,107	10,558,110	89,806,453	11,017,876	75,579,125	9,390,128	108,574,905	15,659,229
Tobacco:										
Wrapper.................do....	4,147,048	4,349,034	5,561,068	5,122,359	6,574,586	5,940,857	5,729,879	5,084,606	6,314,359	4,669,932
Filler and other leaf.....do....	9,888,781	5,551,219	14,058,559	8,174,864	20,276,667	10,349,530	23,698,958	10,127,065	27,702,597	12,564,983
Total ....do....	14,035,829	9,900,253	19,619,627	13,297,223	26,851,253	16,290,387	29,428,837	15,211,671	34,016,956	17,234,915
Vanilla beans ....do....	272,174	1,235,412	255,966	1,209,334	248,988	875,229	361,739	859,399	521,689	1,032,651

[a] Not stated.

[b] No longer classed as a farm product.

Agricultural imports of the United States during the five years ending June 30, 1903—Continued.

Articles imported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Vegetables:										
Fresh or dried—										
Beans and dried pease, bushels	184,499	$165,830	967,031	$1,049,443	1,099,640	$1,306,405	881,966	$1,152,177	1,088,665	$1,420,334
Onions .... bushels..	771,960	499,520	516,798	357,901	774,042	509,552	796,316	608,673	925,599	699,657
Potatoes .... do....	530,420	294,391	155,861	147,349	371,911	224,759	7,656,162	3,160,801	358,505	238,445
Other	....	312,673	....	371,963	....	366,971	....	536,581	....	497,666
Total fresh or dried	....	1,272,414	....	1,926,656	....	2,407,687	....	5,458,232	....	2,856,102
Prepared or preserved—										
Pickles and sauces	....	352,022	....	306,223	....	388,486	....	480,342	....	537,356
Other	....	554,302	....	702,198	....	923,506	....	1,101,261	....	1,187,897
Total prepared or preserved	....	906,324	....	1,008,421	....	1,311,992	....	1,581,603	....	1,725,253
Total vegetables	....	2,178,738	....	2,935,077	....	3,719,679	....	7,039,835	....	4,581,355
Vinegar .... gallons..	93,443	23,534	122,479	30,724	135,883	34,222	168,195	45,754	152,524	42,656
Wafers, unmedicated	....	14,733	....	15,629	....	18,054	....	17,108	....	19,111
Wines. (*See* Liquors, alcoholic.)										
Total vegetable matter	....	311,003,209	....	339,688,064	....	342,249,043	....	335,798,407	....	374,720,111
Total agricultural imports..	....	408,829,147	....	480,772,366	....	449,074,701	....	472,931,606	....	527,677,347

Agricultural exports (domestic) of the United States during the five years ending June 30, 1903.

Articles exported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle .... number..	389,490	$30,516,833	397,286	$30,635,153	459,218	$37,566,980	392,884	$29,902,212	402,178	$29,848,936
Hogs .... do....	33,031	227,241	51,180	394,813	22,318	238,465	8,368	88,330	4,031	40,923
Horses .... do....	45,778	5,444,342	64,722	7,612,616	82,250	8,873,845	103,020	10,048,046	34,007	3,152,159
Mules .... do....	6,755	516,908	43,369	3,919,478	34,405	3,210,267	27,586	2,692,298	4,294	521,725
Sheep .... do....	143,286	853,555	125,772	733,477	297,925	1,933,000	358,720	1,940,060	176,961	1,067,860
Other, including fowls		322,037		289,494		236,319		200,738		149,590
Total		37,880,916		43,585,031		52,058,876		44,871,684		34,781,193
Beeswax .... pounds..	152,494	41,916	319,379	91,913	140,276	39,464	125,283	36,541	70,811	21,337
Bones, hoofs, horns, and horn tips, strips, and waste		195,759		199,194		218,680		163,180		193,817
Bristles		(a)		1,446		3,968		17		515
Dairy products:										
Butter .... pounds..	20,247,997	3,263,951	18,266,371	3,143,509	23,243,526	4,014,905	16,002,169	2,885,609	8,896,166	1,604,327
Cheese .... do....	38,198,753	3,316,049	48,419,353	4,943,609	39,813,517	3,950,999	27,203,184	2,745,597	18,987,178	2,250,229
Milk		1,049,211		1,139,402		1,437,818		1,473,564		921,026
Total		7,629,211		9,226,520		9,403,722		7,104,770		4,775,582
Eggs .... dozens..	3,693,611	641,385	5,920,727	984,081	3,692,875	676,232	2,717,990	528,679	1,517,189	325,571
Egg yolks		10,379		883		1,610		14,700		48,108
Feathers		212,374		280,309		327,966		239,756		141,257
Fertilizer (refuse skins)		1,062		(a)		(a)		(a)		(a)
Fibers, animal:										
Silk waste .... pounds..	128,698	16,075	285,640	53,851	53,398	9,138	81,477	9,759	129,850	19,013
Wool .... do....	1,683,419	237,350	2,200,309	387,239	199,565	26,017	123,278	13,369	518,919	71,818
Total .... do....	1,812,117	253,425	2,485,949	441,090	252,963	35,155	204,755	23,128	648,769	90,831
Glue .... do....	2,368,087	222,072	2,349,014	225,844	2,703,400	254,447	2,907,632	284,413	2,569,164	253,768
Grease. (*See* Meat and meat products.)										
Hair		503,712		676,688		674,881		633,337		616,133
Hides and skins other than furs, pounds	10,140,840	929,117	7,486,256	804,674	11,161,749	1,064,952	9,372,747	906,504	12,859,549	1,224,409
Honey		55,900		30,191		55,574		106,112		64,220

a Not stated.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1903—Continued.

Articles exported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Meat and meat products:										
Meat—										
Beef—										
Fresh.........pounds..	282,139,974	$23,545,185	329,078,609	$29,643,830	351,748,333	$31,851,361	301,824,473	$29,045,056	254,795,963	$25,013,323
Cured—										
Salted or pickled, pounds...........	46,564,876	2,525,784	47,306,513	2,697,340	55,312,632	3,145,219	48,632,727	3,031,027	52,801,220	3,814,671
Other.....pounds..	1,579,313	145,996	2,319,165	197,051	789,285	72,677	818,382	72,836	1,126,032	102,184
Total cured, pounds.........	48,144,189	2,671,780	49,625,678	2,894,391	56,101,917	3,217,896	49,451,109	3,103,863	53,927,252	3,916,855
Canned.......pounds..	38,385,472	3,503,293	55,553,745	5,233,982	53,445,521	5,307,501	66,645,838	6,646,130	76,307,114	7,916,928
Total beef.....do....	368,669,635	29,720,258	434,258,032	37,772,203	461,295,771	40,376,758	417,921,420	38,795,049	385,030,329	36,847,106
Mutton ....do....	379,110	29,427	773,760	64,313	691,121	46,643	430,351	37,067	6,144,020	532,476
Pork—										
Fresh............do....	41,310,364	2,722,661	25,946,905	1,925,772	30,728,586	2,424,537	44,171,674	3,652,464	20,966,113	2,035,491
Cured—										
Bacon ....do....	562,651,480	41,557,067	512,153,729	38,975,915	456,122,741	37,499,026	383,150,624	35,449,797	207,336,000	22,178,525
Hams........do....	225,846,750	20,774,084	196,414,412	20,416,367	216,571,803	22,842,778	227,653,232	25,222,744	214,183,365	25,712,633
Salted or pickled, pounds...........	137,197,200	7,917,066	133,199,683	8,243,797	138,643,611	9,926,633	115,896,275	10,117,562	95,287,374	9,959,762
Total cured, pounds.......	925,695,430	70,248,217	841,767,824	67,636,079	811,338,155	70,268,437	726,700,131	70,790,103	516,806,739	57,850,920
Canned.......pounds..	(a)	(a)	8,496,074	658,402	8,945,594	708,381	9,603,882	832,910	13,590,897	1,369,687
Total pork.....do....	967,005,794	72,970,878	876,210,803	70,220,253	851,012,335	73,401,355	780,475,687	75,275,477	551,363,749	61,256,098
Poultry and game	....	183,503	....	463,905	....	1,070,190	....	856,801	....	1,079,056
Sausage and sausage meat, pounds.................	(a)	(a)	(a)	(a)	9,799,106	923,974	7,137,297	726,437	5,264,648	585,088
Canned meat, n. e. s.......	....	(a)	....	1,724,064	....	1,556,671	....	1,801,385	....	1,831,940
Total meat.............	....	102,904,066	....	110,244,738	....	117,375,591	....	117,492,216	....	102,131,764

Meat products—										
Grease, grease scraps, and other soap stock	....	2,576,507	....	2,944,322	....	3,339,948	....	2,610,925	....	2,926,565
Lard ....pounds..	711,259,851	42,208,465	661,813,663	41,939,164	611,357,514	46,560,148	556,840,222	52,375,864	490,755,821	50,854,504
Lard compounds ....do....	22,144,717	1,200,231	25,852,685	1,475,064	23,359,966	1,449,878	36,201,744	2,687,653	46,130,004	3,607,542
Oils—										
Lard oil ......gallons..	917,007	412,447	738,724	337,260	766,783	438,645	460,035	327,794	356,658	306,334
Oleo oil.......pounds..	142,390,492	9,183,659	146,739,681	10,503,856	161,651,413	11,846,373	138,546,088	12,254,979	126,010,339	11,981,888
Other.........gallons..	166,372	64,368	381,161	172,568	574,209	258,406	352,201	201,535	221,669	159,505
Total oils	....	9,660,474	....	11,013,684	....	12,543,424	....	12,784,298	....	12,447,727
Oleomargarine (imitation butter) ....pounds..	5,549,322	509,703	4,256,067	416,544	4,990,699	484,501	5,721,254	601,521	7,645,652	798,273
Sausage casings............	....	1,571,052	....	2,307,571	....	2,778,854	....	1,795,044	....	1,964,524
Stearin ....pounds..	1,174,167	55,821	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Tallow ....do....	107,361,009	4,367,356	89,030,943	4,393,204	77,166,889	3,848,561	34,065,758	1,924,577	27,368,924	1,623,852
Other	....	5,834,865	....	3,941,394	....	3,212,009	....	3,624,764	....	2,101,785
Total meat products	....	68,084,474	....	68,435,947	....	74,217,323	....	78,404,646	....	76,324,772
Total meat and meat products	....	170,988,540	....	178,680,685	....	191,592,914	....	195,896,862	....	178,456,536
Oils, animal. (*See* Meat and meat products.)										
Quills	....	12,213	....	11,105	....	8,281	....	6,168	....	3,976
Silk waste. (*See* Fibers, animal.)										
Stearin. (*See* Meat and meat products.)										
Wool. (*See* Fibers, animal.)										
Total animal matter.........	....	219,577,981	....	235,239,654	....	256,416,722	....	250,815,851	....	220,997,253
VEGETABLE MATTER.										
Breadstuffs. (*See* Grain and grain products.)										
Broom corn	....	185,902	....	182,520	....	237,863	....	244,358	....	211,253
Broom root (rice root)..........	....	10,975	....	6,140	....	1,708	....	1,798	....	....
Cider ....gallons..	490,803	64,500	483,367	64,283	462,048	61,132	121,006	21,869	598,119	84,084
Cocoa, ground or prepared, and chocolate	....	192,863	....	231,509	....	333,036	....	166,245	....	213,476
Coffee:										
Green or raw.........pounds..	(c)	(c)	(c)	(c)	497,559	72,584	27,088,368	3,209,946	29,233,837	3,295,968
Roasted or prepared.....do....	(c)	(c)	(c)	(c)	(c)	(c)	443,985	71,152	535,108	89,899
Total ....do....	(c)	(c)	(c)	(c)	....	....	27,532,353	3,281,098	29,768,945	3,385,867

a Included in "Other meat products." *b* Included in "Lard Compounds." *c* Not stated.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1903—Continued.

Articles exported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Compressed food	....	(*a*)	....	74,898	....	(*a*)	....	(*a*)	....	(*a*)
Cotton:										
Sea island ... bales	36,213	$2,361,697	46,308	$2,985,378	29,305	$2,237,558	31,771	$2,486,907	51,688	$4,038,370
Sea island ... pounds	14,142,052		18,199,967		11,373,867		12,231,680		20,205,080	
Upland ... bales	7,337,169	207,203,077	6,043,836	238,847,359	6,479,145	311,435,885	6,841,921	288,164,912	6,886,591	312,142,059
Upland ... pounds	3,759,268,241		3,082,383,221		3,319,516,581		3,488,547,083		3,522,837,942	
Waste cotton ... pounds	14,308,829	524,802	25,642,400	1,156,241	28,171,912	1,431,604	28,195,873	946,537	26,098,947	884,842
Total ... do	3,787,719,122	210,089,576	3,126,225,588	242,988,978	3,359,062,360	315,105,047	3,528,974,636	291,598,356	3,569,141,969	317,065,271
Flowers, cut	....	2,355	....	4,169	....	1,787	....	4,788	....	5,290
Forest products:										
Bark, and extracts of, for tanning	....	369,693	....	376,742	....	386,238	....	288,012	....	239,786
Charcoal	....	5,524	....	1,598	....	4,164	....	4,929	....	5,118
Naval stores:										
Rosin ... barrels	2,563,229	3,741,581	2,369,118	3,796,367	2,820,815	4,742,457	2,535,962	4,202,104	23,964,498	4,817,205
Tar ... do	36,903	86,002	36,535	77,082	32,135	77,669	23,236	55,854	18,622	50,802
Turpentine and pitch, barrels	22,945	54,953	20,246	45,823	18,391	45,795	18,370	44,356	15,972	36,379
Turpentine, spirits of, gallons	17,761,533	6,100,419	18,090,582	8,554,922	20,240,851	7,715,029	19,177,788	7,431,248	16,378,787	8,014,322
Total	....	9,982,955	....	12,474,194	....	12,580,950	....	11,733,562	....	12,918,708
Wood:										
Timber—										
Round	....	3,262,589	....	5,020,471	....	3,608,092	....	3,343,908	....	4,506,728
Hewn ... cubic feet	4,796,658	818,841	4,416,741	785,305	4,624,698	802,528	5,388,439	1,030,687	3,291,498	787,082
Sawed ... M feet	406,448	4,161,097	473,542	5,763,390	533,920	6,876,686	412,750	5,225,003	580,659	7,462,111
Total timber	....	8,242,527	....	11,569,166	....	10,787,306	....	9,599,598	....	12,755,921
Lumber—										
Boards, deals, and planks ... M feet	970,170	15,031,176	1,046,758	17,731,696	1,101,815	20,106,242	942,814	16,978,322	1,065,771	20,965,328
Joists and scantling, M feet	34,294	371,840	41,043	550,495	41,496	572,704	37,885	472,384	46,894	647,920
Shingles ... M	73,791	126,939	86,118	169,667	39,255	89,588	33,224	86,799	38,211	86,245

Shooks—										
Box		434,290		587,047		590,271		700,035		779,777
Other ....number..	616,380	588,961	773,019	728,753	714,651	882,438	788,241	798,884	566,205	829,248
Total shooks		1,023,251		1,315,800		1,472,709		1,498,919		1,609,025
Staves and Heading—										
Heading		177,006		78,146		137,961		123,376		134,383
Staves....number..	44,382,689	3,720,207	49,011,533	4,337,418	47,363,262	3,757,048	46,998,512	3,830,432	55,879,010	4,740,680
Total staves and heading		3,897,213		4,415,564		3,895,009		3,953,808		4,875,063
Other		3,081,295		3,613,190		4,422,384		3,572,328		3,732,782
Total lumber		23,531,714		27,796,412		30,558,636		26,562,560		31,916,363
Total wood		31,774,241		39,365,578		41,345,942		36,162,158		44,672,284
Wood pulp ....pounds..	55,932,270	696,319	28,554,801	458,463	61,528,437	1,051,867	38,348,632	740,103	22,464,472	445,228
Total forest products		42,828,732		52,676,575		55,369,161		48,928,764		58,281,124
Fruits and nuts:										
Fruits—										
Fresh or dried—										
Apples, fresh..barrels..	380,222	1,210,459	526,636	1,444,655	883,673	2,058,964	459,719	1,628,886	1,656,129	4,381,801
Apples, dried.pounds..	19,305,739	1,245,733	34,964,010	2,247,851	28,309,023	1,510,581	15,664,468	1,190,593	39,646,297	2,378,635
Apricots, dried ..do....	(a)	(a)	(a)	(a)	(a)	(a)	1,928,367	178,143	9,190,081	713,887
Oranges		282,313		271,468		436,560		420,835		465,397
Prunes ......pounds..	5,615,565	380,847	25,922,371	1,646,332	10,021,564	589,113	23,358,849	1,404,422	66,385,215	3,512,507
Raisins ....do....	4,659,807	242,620	2,415,456	139,689	3,512,164	218,715	2,323,274	149,216	4,280,028	284,530
Other		1,997,649		2,545,451		2,716,269		2,153,050		4,215,034
Total fresh or dried		5,359,621		8,295,446		7,530,202		7,125,145		15,951,791
Preserved—										
Canned		2,330,715		3,127,278		3,006,109		1,195,635		1,739,571
Other		66,899		63,448		71,597		94,323		66,757
Total preserved		2,397,614		3,190,726		3,077,706		1,289,958		1,806,328
Total fruits		7,757,235		11,486,172		10,607,908		8,415,103		17,758,119
Nuts		140,250		156,490		218,743		304,241		299,558
Total fruits and nuts		7,897,485		11,642,662		10,826,651		8,719,344		18,057,677
Ginseng ....pounds..	196,196	782,545	160,901	833,710	149,069	801,672	154,063	856,515	151,985	796,008
Glucose and grape sugar ....do....	229,003,571	3,624,890	221,901,459	3,600,139	204,209,974	3,113,898	130,419,611	2,319,280	126,239,981	2,460,022

a Not stated.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1903—Continued.

Articles exported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Grain and grain products:										
Grain—										
Barley .... bushels..	2,267,403	$1,375,274	23,661,662	$11,216,694	6,293,207	$2,883,565	8,714,268	$3,995,303	8,429,141	$4,662,544
Buckwheat .... do....	1,533,980	846,028	426,822	254,847	123,540	79,120	719,615	449,917	117,953	75,713
Corn (maize) .... do....	174,089,094	68,977,448	209,348,284	85,206,400	177,817,965	82,527,983	26,636,552	16,185,673	74,833,257	40,540,637
Oats .... do....	30,309,778	9,787,540	41,369,415	12,504,654	37,146,812	11,765,330	9,971,139	4,153,238	4,613,809	1,850,728
Rye .... do....	10,140,866	5,936,078	2,355,792	1,442,055	2,326,882	1,321,979	2,697,863	1,581,491	5,422,731	3,143,910
Wheat .... do....	139,432,815	104,269,169	101,950,389	73,237,080	132,060,667	96,771,743	154,856,102	112,875,222	114,181,420	87,795,104
Total grain .... do....	357,773,936	191,191,537	379,112,364	183,861,730	355,769,073	195,349,720	203,595,539	139,240,844	207,598,291	138,068,636
Grain products—										
Meal and flour—										
Corn meal .... barrels..	791,488	1,775,868	943,782	2,148,410	896,877	2,065,432	348,034	1,046,643	451,506	1,382,127
Oatmeal ...... pounds..	58,042,505	1,295,988	66,229,950	1,547,900	92,198,138	2,308,649	59,516,512	1,617,298	67,823,935	1,839,106
Rye flour ..... barrels..	4,826	15,015	4,370	14,757	3,105	10,860	2,369	8,403	3,757	12,818
Wheat flour ..... do....	18,485,690	73,093,870	18,699,191	67,760,886	18,650,979	69,459,296	17,759,203	65,661,974	19,716,484	73,756,404
Total meal and flour.	....	76,180,741	....	71,471,953	....	73,844,237	....	68,331,318	....	76,990,455
Bran, middlings, and mill feed .... tons..	127,953	2,002,588	166,604	2,638,719	79,358	1,383,246	48,980	962,595	49,513	945,053
Malt .... bushels..	453,038	324,145	296,742	215,198	357,947	250,099	401,375	266,894	347,147	252,801
Malt sprouts	....	55,177	....	62,266	....	(a)	....	(a)	....	(a)
Distillery and brewery refuse .... tons..	(a)	(a)	(a)	(a)	59,136	992,836	66,846	1,157,636	73,104	1,320,065
Breadstuff preparations—										
Bread and biscuit, pounds	16,447,430	809,998	18,329,815	938,513	12,420,325	606,811	11,641,411	604,136	11,104,575	589,536
Other	....	2,133,110	....	2,362,715	....	2,832,930	....	2,205,018	....	2,667,409
Total breadstuff preparations	....	2,943,108	....	3,301,228	....	3,439,741	....	2,809,154	....	3,256,945
All other	....	1,681,725	....	1,470,448	....	584,838	....	629,797	....	661,131
Total grain products.....	....	83,187,484	....	79,159,812	....	80,494,997	....	74,160,394	....	83,426,450
Total grain and grain products	....	274,379,021	....	263,021,542	....	275,844,717	....	213,401,238	....	221,495,086

Grasses, dried	....	26,063	....	20,148	....	18,295	....	18,001	....	15,294
Hay ....tons..	64,916	858,992	72,716	992,741	89,364	1,476,870	153,431	2,580,622	50,974	828,483
Hops ....pounds..	21,145,512	3,626,144	12,639,474	1,707,660	14,963,676	2,466,515	10,715,151	1,550,657	7,794,705	1,909,951
Lard substitutes. (*See* Meat and meat products.)										
Liquors, alcoholic:										
Distilled spirits—										
Alcohol, including cologne spirits, proof galls..	1,476,028	427,288	177,974	59,277	237,509	97,633	367,538	220,453	120,697	23,510
Brandy ....do....	20,944	29,289	80,259	83,698	15,323	28,176	24,077	30,174	18,117	19,213
Rum ....do....	850,719	1,175,306	670,410	903,808	1,076,711	1,468,110	1,095,401	1,425,920	1,096,719	1,458,393
Whisky—										
Bourbon ....do....	224,918	267,865	863,241	764,860	525,372	687,969	611,518	638,061	169,396	203,137
Rye ....do....	99,884	156,617	91,721	121,241	160,357	251,583	155,046	275,717	104,236	223,480
Total whisky, proof gallons..........	324,802	424,482	954,962	886,101	685,729	939,552	766,564	913,778	273,632	426,617
Other ....do....	19,536	24,372	18,585	24,921	23,562	44,670	76,384	82,950	48,014	62,358
Total distilled spirits, proof gallons	2,692,029	2,080,737	1,902,190	1,957,805	2,038,834	2,578,141	2,329,964	2,673,275	1,557,179	1,990,091
Malt liquors—										
Unbottled ....gallons..	602,055	154,751	761,411	194,157	333,666	79,508	417,025	90,769	400,072	95,758
Bottled .....dozen quarts..	1,433,799	1,733,373	1,578,240	1,945,059	1,351,779	1,643,517	822,899	1,199,293	759,027	1,082,982
Total malt liquors	....	1,888,124	....	2,139,216	....	1,723,025	....	1,290,062	....	1,178,740
Wines—										
Unbottled ....gallons..	1,498,078	624,315	1,408,859	575,665	1,117,858	461,560	929,900	407,345	678,150	290,552
Bottled .....dozen quarts..	10,973	52,015	9,854	49,927	9,901	43,013	10,952	42,980	5,232	24,624
Total wines	....	676,330	....	625,592	....	504,573	....	450,325	....	315,176
Total alcoholic liquors ..	....	4,645,191	....	4,722,613	....	4,805,739	....	4,413,662	....	3,484,007
Malt. (*See* Grain and grain products.)										
Malt liquors. (*See* Liquors, alcoholic.)										
Malt sprouts. (*See* Grain and grain products.)										
Nursery stock	....	134,929	....	107,172	....	134,961	....	132,027	....	158,959

a Not stated.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1903—Continued.

Articles exported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Oil cake and oil-cake meal:										
Corn .... pounds..	1,922,264	$17,623	4,888,776	$48,783	12,703,209	$131,774	14,740,498	$164,056	8,093,222	$95,568
Cotton-seed .... do....	1,079,993,479	9,253,398	1,143,704,342	11,229,188	1,258,687,317	13,119,968	1,050,466,246	12,271,009	1,100,392,988	12,732,497
Flaxseed, or linseed..... do....	487,177,390	5,277,744	483,130,182	5,528,331	455,154,860	5,471,930	582,886,875	7,508,133	570,908,149	7,011,214
Total .... do....	1,569,093,133	14,548,765	1,631,723,300	16,806,302	1,726,545,386	18,723,672	1,648,093,619	19,943,198	1,679,394,359	19,839,279
Oils, vegetable:										
Fixed or expressed—										
Corn .... gallons..	2,360,623	565,293	4,383,926	1,351,867	4,808,545	1,831,980	4,266,398	1,769,370	3,788,035	1,467,493
Cotton-seed .... do....	50,627,219	12,077,519	46,902,390	14,127,538	49,355,741	16,541,321	33,042,848	12,992,393	35,642,994	14,211,244
Linseed .... do....	107,000	47,681	103,494	54,148	99,919	66,653	102,116	68,617	182,330	98,116
Other	....	838,257	....	554,781	....	363,056	....	220,372	....	169,796
Total fixed or expressed..	....	13,528,750	....	16,088,334	....	18,803,010	....	15,050,752	....	15,946,649
Volatile, or essential—										
Peppermint ...... pounds..	117,462	118,227	89,558	90,298	60,166	63,672	36,301	54,898	13,033	34,943
Other	....	162,358	....	166,424	....	169,004	....	202,983	....	252,770
Total volatile, or essential.........................	....	280,585	....	256,722	....	232,676	....	257,881	....	287,713
Total vegetable oils	....	13,809,335	....	16,345,056	....	19,035,686	....	15,308,633	....	16,234,362
Rice, rice meal, etc.:										
Rice .... pounds..	852,704	38,511	12,947,009	500,364	1,078,958	42,807	615,036	29,707	532,092	27,048
Rice bran, meal, and polish, pounds.........................	14,481,985	80,298	28,119,408	167,023	24,448,888	143,922	28,976,238	228,010	19,218,356	122,589
Total .... pounds..	15,334,689	118,809	41,066,417	667,387	25,527,846	186,729	29,591,274	257,717	19,750,448	149,637
Rice root. (*See* Broom root.)										
Root beer .... dozen quarts..	(*a*)	(*a*)	3,439	4,661	1,751	2,018	712	1,014	949	834
Roots, herbs, and barks, n. e. s	....	169,828	....	237,527	....	275,150	....	290,692	....	320,122
Seeds:										
Cotton .... pounds..	34,443,806	197,023	49,855,238	346,230	43,329,257	366,953	56,403,344	509,627	51,622,370	532,732
Flaxseed, or linseed..bushels..	2,830,991	2,815,449	2,743,266	3,475,417	2,755,683	4,319,102	3,874,033	6,031,887	4,128,130	5,698,492

Grass seed—										
Clover..........pounds..	19,980,434	1,264,922	32,069,371	2,379,372	11,998,674	1,063,506	7,256,573	594,733	15,522,527	1,549,687
Timothy..........do....	16,149,611	492,710	15,078,186	505,758	7,275,806	296,640	5,966,986	373,046	18,289,917	853,829
Other..................	....	156,200	....	165,063	....	144,948	....	315,556	....	581,773
Total grass seed..........	....	1,913,832	....	3,050,193	....	1,505,094	....	1,283,335	....	2,985,289
All other seeds..............	....	153,092	....	165,142	....	193,666	....	202,975	....	238,770
Total seeds..............	....	5,079,396	....	7,036,982	....	6,384,815	....	8,027,824	....	9,455,283
Spices..................	....	2,257	....	19,131	....	20,204	....	23,471	....	36,787
Spirits, distilled. (*See* Liquors, alcoholic.)										
Starch..................pounds..	110,193,776	2,292,843	124,935,963	2,604,362	102,800,725	2,005,865	28,183,967	656,705	27,759,599	832,943
Straw..................	....	4,737	....	4,200	....	5,328	....	5,092	....	1,747
Sugar, molasses, and sirup:										
Molasses..........gallons..	5,682,080	444,392	3,892,374	434,585	2,495,638	291,063	2,911,509	416,470	3,413,387	492,260
Sirup..............do....	10,070,650	1,465,849	11,139,770	1,682,202	15,092,321	2,235,014	14,865,744	2,048,561	12,265,295	1,714,899
Sugar—										
Raw..........pounds..	403,119	14,275	322,252	11,262	147,221	6,056	359,402	14,089	99,101	3,545
Refined..........do....	9,462,228	426,202	22,192,351	1,004,135	8,727,639	437,523	7,213,050	292,715	10,421,055	358,537
Total sugar........do....	9,865,347	440,477	22,514,603	1,015,397	8,874,860	443,579	7,572,452	306,804	10,520,156	362,082
Total sugar, molasses, and sirup..............	....	2,350,718	....	3,132,184	....	2,969,656	....	2,771,835	....	2,569,241
Teasels..................	....	19,466	....	21,882	....	25,079	....	23,161	....	34,258
Tobacco:										
Leaf..............pounds..	272,421,295	25,170,771	334,604,210	29,163,086	306,900,934	27,475,466	291,369,700	26,881,641	357,496,342	34,972,033
Stems and trimmings....do....	11,191,827	296,447	10,051,487	259,285	8,886,848	181,009	9,687,665	222,355	10,687,742	278,860
Total..............do....	283,613,122	25,467,218	344,655,697	29,422,371	315,787,782	27,656,475	301,007,365	27,103,996	368,184,084	35,250,893
Vegetables:										
Fresh or dried—										
Beans and peas...bushels..	883,201	1,269,812	617,355	983,401	468,670	862,088	324,481	636,345	232,841	530,875
Onions..............do....	164,902	134,250	171,636	143,256	165,391	144,030	113,531	117,019	145,509	116,624
Potatoes............do....	579,833	450,739	809,472	626,791	741,483	518,621	528,484	564,550	843,075	552,533
Total fresh or dried, bushels..............	1,627,936	1,854,801	1,598,463	1,753,448	1,375,544	1,524,739	966,496	1,317,914	1,221,425	1,200,032

a Not stated.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1903—Continued.

Articles exported.	1899.		1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Vegetables—Continued.										
Prepared or preserved—										
Canned		$555,691		$603,288		$528,914		$560,612		$597,759
Other		388,908		496,542		544,764		667,761		745,697
Total prepared or preserved		944,599		1,099,830		1,073,678		1,228,373		1,343,456
Total vegetables		2,799,400		2,853,278		2,598,417		2,546,287		2,543,488
Vinegar ... gallons	107,317	13,488	115,372	12,583	83,780	13,231	95,675	19,751	103,417	18,072
Wines. (*See* Liquors, alcoholic.)										
Yeast		36,061		8,086		6,809		8,439		24,524
Total vegetable matter, including forest products		616,062,484		662,053,451		750,580,770		655,226,446		715,763,322
Total agricultural exports, including forest products		835,640,465		897,293,105		1,006,997,492		906,042,297		936,760,575
Total animal and vegetable matter, excluding forest products		792,811,733		844,616,530		951,628,331		857,113,533		878,479,451

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